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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

The staff of *Engineering News-Record* consists of

New York: E. J. Mehren, *Editor;* F. C. Wight, *Managing Editor;* M. N. Baker, F. E. Schmitt, R. K. Tomlin, Jr., C. S. Hill, J. W. Shaver and V. T. Boughton.

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An Extraordinary Structure

THE Los Angeles theater described in this issue is a remarkable example of reinforced-concrete design. There have been other theaters built of this material but so far as we can now find reference there has never been one with such long and large girders and trusses. Indeed the 126-ft. girders here are, we believe, the longest span concrete beams ever built. To Eastern engineers, fairly convenient to the structural steel mills, there will certainly arise doubts as to the economy of these huge beams and trusses in competition with a steel frame, but conditions on the West Coast are different and it is to be noted that the designing engineer says that his structure figured at less cost than one of steel. Then, too, there will be those who look askance on the tremendous concentration of steel in the large members and who will doubt the possibility of completely surrounding the rods with steel or of guaranteeing the interaction of steel and concrete once both are placed and under load. These, however, are merely questions; the Los Angeles engineers are answering them pragmatically. The Grauman theater design is made; the building is up; it works.

Engineering Societies as Public Advisers

EMPHASIS of the rôle of the engineering society as a watchdog of the public treasury, having wide duties and opportunities in relation to the economic aspect of public improvements, was the keynote of the presidential speech of C. A. Morse at the recent annual dinner of the Western Society of Engineers. As an unbiased expert the engineer is specially qualified to inform and advise the public on matters in which its vote is involved, so that reports or statements of society committees may have—and should have—a large influence in public welfare. This opportunity of the engineering society was illustrated by Mr. Morse in regard to bond issues. In the first place there is the question of the issue itself, the vote on which is determined usually by personal opinion or prejudice as to the amount involved and the desirability of the improvement. Further, the public has little comprehension of the subsequent expense involved in maintenance and operation of public works. In fact, Mr. Morse considers that many a bond issue would be defeated if the voters understood that it covered first cost only and would entail heavy and continual future expense. One of the most important functions of an engineering society in taking an active part in public affairs, should be not only to check unwise expenditures for new improvements but also to promote proper maintenance and operation of existing works.

How To Do It

IN THE victory of the New York City engineers in saving High Bridge last week it was this attention to the economic side that apparently turned the tide, although the representatives of the societies are to be congratulated on their persistence in continued fighting for what appeared at times to be a lost cause. The Board of Estimate of the city was not much impressed with the sentimental regard that engineers and architects had for this early monument to American engineering skill but when they were shown that the new siphon required by the destruction of the bridge aqueduct plus the demolition itself would cost more than an artistic revision of the bridge, continuing thereon the aqueduct, they reversed their decision to tear High Bridge down. Engineering societies can get action if their cause is just and they know how to present it.

City Freight Belt Railways

REROUTING through freight traffic around large cities by means of loop or cut-off lines, in order to avoid congestion of busy local centers, has been extensively practiced in recent years, but the Flint belt line described in this issue serves two other purposes. In the first place, it will so relieve conditions on a line crossing the city at grade that costly track elevation projects are likely to be postponed indefinitely. In the second place it provides direct railway connection and switching service for a large industrial district established in the outlying part of the city by local interests in order to encourage the location of large manufacturing plants. Belt lines are an increasingly important feature in city and industrial development. L. F. Loree in his new book on "Railroad Freight Transportation," summarizes the situation well in the following sentences: "It seems quite certain that recent practice and experience is tending toward a recognition of the value of the belt line as one of the mechanical

elements of a comprehensive district clearing system. As a means for controlling and directing urban development along the rational lines of a wholesome city plan, the belt line appears to have been rather neglected. Of course, Chicago with its four concentric belt lines and New Orleans, Indianapolis and San Francisco are examples to the contrary. But this is especially true in the smaller but rapidly growing industrial centers. And here, if not in the older and larger cities, this feature of terminal organization might well receive further study and development."

New Opportunities

RATHER tardily, perhaps, but with the active approval of its membership the American Society for Testing Materials has decided to undertake the conscious stimulation and cultivation of research in materials. Heretofore its field has been limited quite narrowly to making specifications, and the committees have taken only incidental notice of the various deficiencies in knowledge of materials which their work revealed. It is true that many results of research were presented at the society's meetings, comprising the voluntary contributions of research investigators and the reports of studies carried out to clear up doubtful points about specifications. But all such papers had to edge their way into the program, so to say, and were not recognized as vital parts of the society's work. Moreover, when a committee encountered a new problem it had no encouragement to go into a study of this problem beyond what the purposes of the specification in hand required. But now that the development of new knowledge—study of materials and their behavior under various conditions, and of instruments and methods for observing this behavior—is established in recognized position as a main objective of the society's existence, new opportunities are opened up. Research will no longer be in the position of tagging along as a mere auxiliary of specification-making; it can thrive as an independent activity. To what extent this activity can or should be organized and systematized may yet need to be considered, though the achievements in the field of organized research are not particularly encouraging. Regardless of this detail, however, the society is entitled to congratulations on its forward-looking step. It has assumed a larger responsibility and assured itself a future of increased value to the world.

Efficiency Versus Tradition

WITH this hopeful reflection the observer of last week's meeting of the society is bound to couple a less optimistic thought. For a long time the society has enjoyed the distinction of having the longest and most unwieldly meetings among all our many technical societies, and it confirmed its claim to this title by the past week's meeting, which extended from Monday evening to the small hours of Saturday morning. With the help of a touch of very hot weather the meeting came near to wearing out the patience of many members in attendance—an effect not favorable to active thought and animated discussion. There has been in recent years a very marked slackening of activity on the meeting floor of the society. This has been coincident with increase in the length of the meetings; and while it would be unreasonable to argue herefrom a direct cause-and-effect connection, it would be just as unreasonable to deny that length of meeting had a contributory influence. The society's practice in the makeup of its programs has always been out of square with the principle and experience of other technical organizations, but it has been successful enough in the past to give color to the claim that the American Society for Testing Materials is quite exceptional in that its meeting is in effect a series of meetings, attended by successive relays of members. Even this fact, in so far as it is a fact, is of limited bearing on the matter, and cannot forever justify adherence to a precedent that may have been outlived. Continuing growth of its work, and increasing breadth and complexity of the interests concerned, demand that concentration and efficiency should be made prime ingredients of its meetings. These elements, however, are incompatible with programs so long as to tax the endurance and deaden discussion. Where efficiency demands, even tradition must yield.

For Improved Structural Knowledge

NOTABLE extension of the possibilities of strain measurement in engineering structures is in prospect if two new instruments brought to notice at the American Society for Testing Materials meeting last week carry out their full promise. One is a distant-reading extensometer, the other a highly sensitive and yet convenient and rugged instrument of the optical-lever type. Both were developed at the Bureau of Standards. A third instrument of equal importance, the photo-recording strain-gage of the Bureau of Public Roads, was described only a short time ago. Thus within the short space of a few months the art of structural investigation is enriched by a group of three new tools which add greatly to its resources. What they will accomplish is yet a matter of the future, but some indication of possibilities is given by their use for measuring stresses in airplane stay cables during flight, deformations in riveted joints, and impact in bridges, respectively. It is now possible, in other words, to follow the stress changes in inaccessible parts, to measure very minute, localized distortions, and to direct and record rapid changes of strain, even the high-speed vibrations occurring in bridges, all of which has not hitherto been practicable. This extension of our powers virtually assures important advance in structural engineering knowledge when the instruments are fully utilized.

Railroad Activities Ahead

NUMEROUS summarized programs of individual railroads which have been published in our news pages during the past few months indicate that the construction season of 1923 is to be exceptionally active in railroad work. As examples, there are the contemplated expenditures of $50,000,000 by the Louisville & Nashville, $41,000,000 by the Illinois Central, $12,000,000 by the Philadelphia & Reading, $6,000,000 by the Rock Island and $3,000,000 each by the Nickel Plate and the Frisco lines. In most of these projects new construction and extension are relatively insignificant. Probably 85 or 90 per cent of the expenditure is for the improvement of existing lines by grade and line revision, additional main tracks and passing tracks, freight yards and yard extensions, engine terminals and various facilities. Furthermore, a large proportion of the small item of new line construction represents relief or cut-off lines built to increase traffic

capacity or operating efficiency rather than lines to open up new districts or develop new traffic resources. Part of this present and prospective activity is due to the necessity of making good the improvements deferred under war conditions, but the greater part is due to the growth of traffic which necessitates increase of facilities on existing lines rather than the extension of lines to produce additional traffic from new sections of settlement and cultivation. But although present attention is concentrated on improvement work the railway system is far from complete, and there is still future work for the pioneer and the locating engineer in new country, as well as for the engineer with the problem of the economic possibilities of improving operated railways.

To what extent the above improvement programs can be carried out during the present season will depend largely upon conditions of labor, wages and material supply and prices. But even if all the prospective work should be completed there is plenty more needing to be done as long as financial and political conditions will permit the railroads to proceed with adequate improvements and developments to bring the railroad system abreast of the country's needs.

Business Man or Administrator

WITH commendable promptness both the American Society of Civil Engineers and the Federated American Engineering Societies have put in motion investigations into the removal of Director Davis of the United States Reclamation Service. The issue is more than the injustice done to one engineer, however great that may be. The removal, or more particularly the appointment of Governor Davis, implies a charge against the whole engineering profession, to which the professional organizations must reply. And to formulate that reply those organizations must have all the facts. The Secretary of the Interior can hardly continue to maintain his reticence before the representatives of the engineers of the country, when they come before him for an explanation of the accusation that engineers are incapable of conducting an engineering organization.

Herein lies the seriousness of the Davis incident; that it may well be the beginning of a movement at Washington to make the government engineers merely the day-laborers of engineering work, the bosses of the concrete gangs, the instrument men of the surveys, the draftsmen and the estimators, leaving the direction of all of these to the so-called business man, who changes with each new administration or even with the political exigencies of the administration itself. It may mean a complete about-face from the ideal of engineering direction of government engineering work, which the profession knows itself competent to assume to the benefit of the country, and which would result from a properly organized department of public works.

Dr. Work, in one of his few announcements, defends himself with the statement that the work of the Reclamation Service has largely passed beyond the engineering stage and has become a business, that the chief engineer will continue to have charge of all engineering details but that this business operation must be in charge of a business man—the new commissioner at Washington being of that type. Passing over the obvious triteness of this glorification of the "business man," which name covers such a multitude of sins, it may be worth while to examine into this business of irrigation and to find out wherein the engineer is disqualified for it and the groceryman and banker qualified.

What does the Reclamation Service do? It designs and builds irrigation systems with government funds, it operates or supervises those systems after they are built for the benefit of settlers who pay the government for the land and the service at certain rates fixed by law. The design and construction are obviously engineering, the service is certainly engineering; there remains then only the matter of payment and the relations between the government and the settler. Is this more a matter for the business man than for the engineer? Is there anything inherent in the man who buys and sells which makes him better suited to deal with a group of farmers than a man who not only has designed and built the thing those farmers are using but also is in constant touch with their problems through the daily operation of that which they use?

It is not a "business man" that this business of irrigation calls for; it is an altogether different kind of person—an administrator. The Secretary's defense confuses these two terms. The engineer does not claim to be a "business man." He does not buy things which he later sells at a profit, he does not take chances in the hope that a successful guess will outweigh in profits the losses from half-a-dozen unsuccessful ones. He is trained to learn facts and to proceed from those facts in orderly steps to a desired and desirable end. When in the individual he combines this method of practice with a knowledge of how to deal with men he becomes the ideal administrator, especially so when the field of his administration lies within the range of his specialized technical knowledge. The railroads are fast finding this out; is the government business so different that the rule does not hold? Is not the Secretary of the Interior acquainted with the Secretary of Commerce?

The question might be put to the Secretary in a somewhat more personal way. He is a doctor of medicine, a leading practitioner in that profession, we are assured; he has, in fact, been president of the American Medical Association. He also conducts a hospital, a matter which would seem to require a deal of so-called business ability. Does he think that it is necessary in the conduct of that hospital to bring in a business man to supervise his work and correct his judgment; would he insist on the appointment of another such business man to supervise the doctors in charge of the government hospitals? Or does he think that the profession of medicine is less technical than that of engineering and that the practitioners of the former have opportunities for administrative development not permitted the latter?

Doubtless the committees of the engineering societies will present some of these considerations to the Secretary. The day is past when the assumption that the engineer is a narrow specialist can be allowed to go unchallenged. As we said last week the whole morale of the government engineering service is imperilled, but more than that there is here an opportunity to take advantage of what bears all the earmarks of a political maneuver to give the people of the United States some understanding of the breadth of training and experience of the engineering profession.

Huge Concrete Girders and Trusses in New Theater

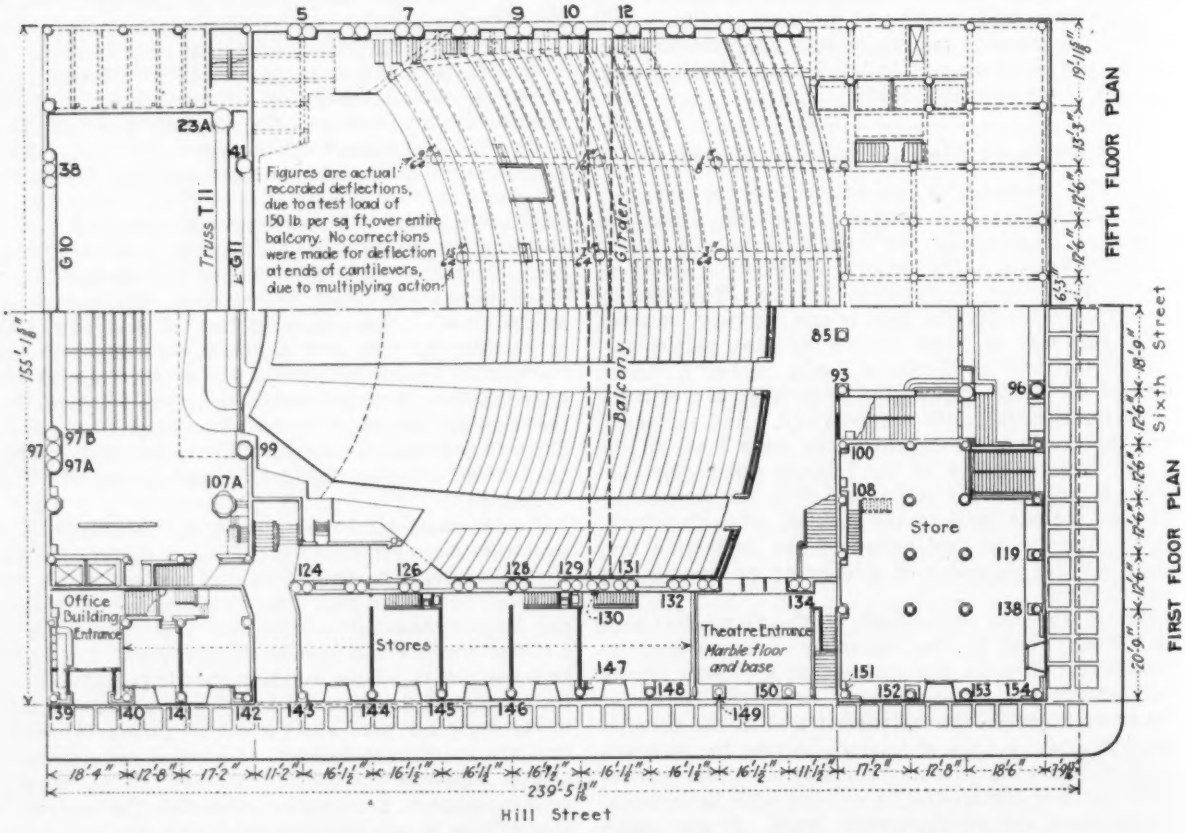
Grauman's Theater and Office Building in Los Angeles Contains Reinforced-Concrete Roof Trusses 126-Ft. Span, Large Cantilever Truss Under Balcony and Girders Up to 126-Ft. Span

By Roy C. Mitchell
Engineer, Edwin Bergstrom, Architect, Los Angeles, Calif.

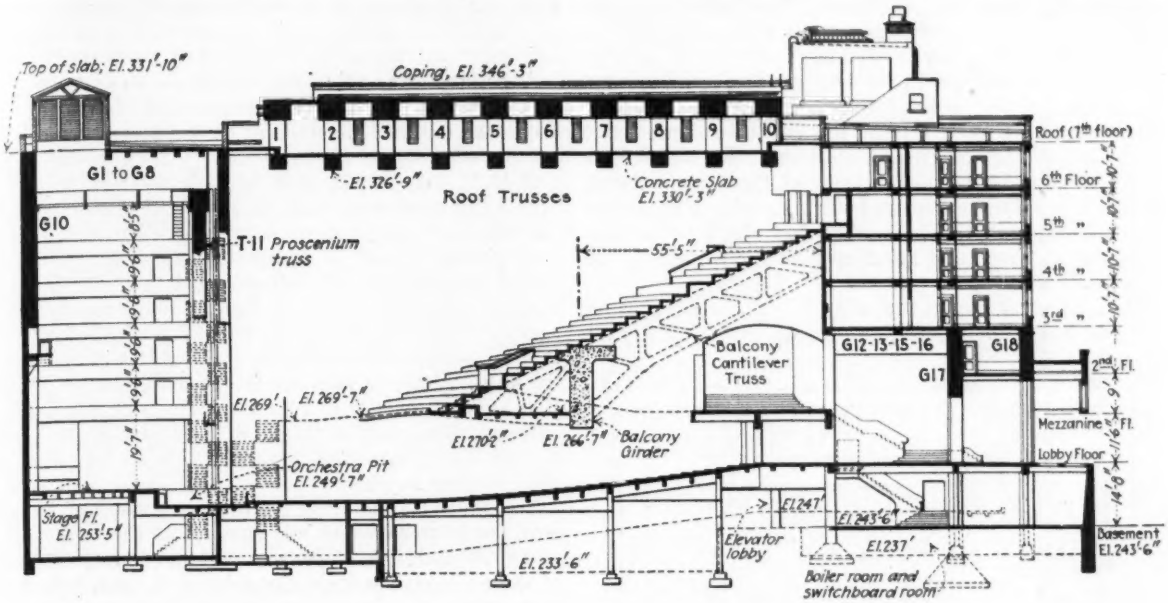
GRAUMAN'S Metropolitan theater and office building at Sixth and Hill Sts., Los Angeles, is a monumental piece of reinforced-concrete construction; other structures may have a larger volume of cubic content or number of cubic yards of concrete used, but from a standpoint of extraordinary structural design as varied as the component parts of a theater building and on the stupendous scale with which it was carried out, it has no equal in building construction. The main structural features are the ten 126-ft. span roof trusses; the cantilever balcony construction and the great 126-ft. girder which carries it; the framing over the main lobby with the marquise extending out 12 ft. from the building, with terra-cotta facing; the heavy girders over the stage supported by a large truss and girders over the proscenium arch and the large combined footing under the stage. There was used in this entire structure 2,700 tons of reinforcing steel, 84,000 cu. yd. of concrete, 127,000 bbl. of cement and 1,500,000 ft. of lumber.

This theater and office building, in general, is thirteen stories in height, with a frontage of 240 ft. on Hill St., 155 ft. on Sixth St., with an alley extending along the east side and the property line along the north side. Grauman's Theater will occupy the greater part of the building, with a seating capacity of 3,900. The offices, one tier deep along the Hill and Sixth St. sides, extend up to the seventh floor. From the seventh floor up the office portion of the building will be a U-shape plan, 48 ft. deep on each side. Above the seventh floor this office portion will be over the entire stage, along the alley side, extending out 48-ft. over the theater auditorium, which is supported on the reinforced-concrete roof trusses, and also along the entire Sixth St. frontage.

When the original plans were made, the building was to be a combination of structural steel and reinforced concrete. The main girders, trusses and framing over the stage were to be of structural steel on steel columns, but owing to the exorbitant price which was asked for the 1,500 tons of structural steel at that time, it made it almost prohibitive in going ahead with this building unless some other means could be devised for


FIFTH FLOOR PLAN
FIRST FLOOR PLAN
Figures are actual recorded deflections, due to a test load of 150 lb. per sq. ft. over entire balcony. No corrections were made for deflection at ends of cantilevers, due to multiplying action.
Truss T11
Girder
Balcony
Store
Stores
Office Building Entrance
Theatre Entrance
Marble floor and base
Sixth Street
Hill Street
239'-5 11/16"

PLAN OF GRAUMAN'S THEATER SHOWING LOCATION OF TRUSSES AND HEAVY GIRDERS



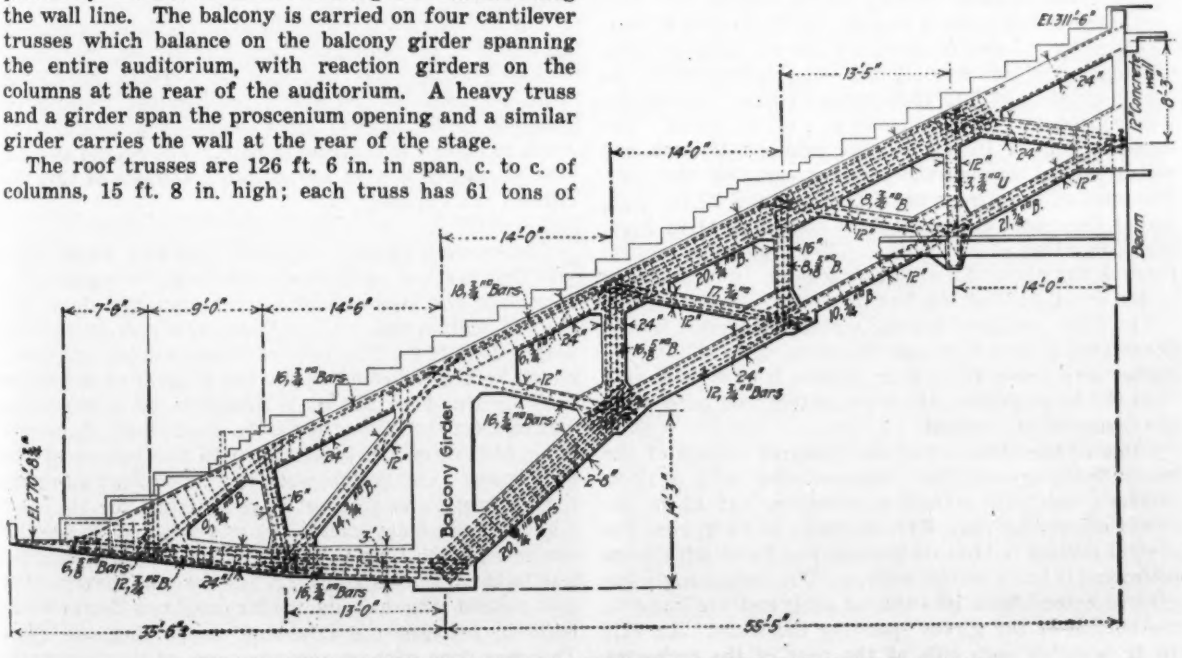
SECTION THROUGH AUDITORIUM OF GRAUMAN'S THEATER, LOS ANGELES

Note heavy trusses over stage and over auditorium. Large balcony cantilever and girder are of reinforced concrete.

lessening the cost. Upon investigation it was found that by making the structure of reinforced concrete a big saving, both in money and in time could be made. If the steel construction were used all of the trusses over the auditorium would have had to be shipped knocked down and later riveted up on a falsework; also this steel framing would have had to be fireproofed which would make the members approximately the same size as members used in a reinforced-concrete truss.

The disposition of the structural members may be noted from the plans and sectional elevations given herewith. The auditorium is clear, the roof being supported by the 126-ft. trusses resting on columns along the wall line. The balcony is carried on four cantilever trusses which balance on the balcony girder spanning the entire auditorium, with reaction girders on the columns at the rear of the auditorium. A heavy truss and a girder span the proscenium opening and a similar girder carries the wall at the rear of the stage.

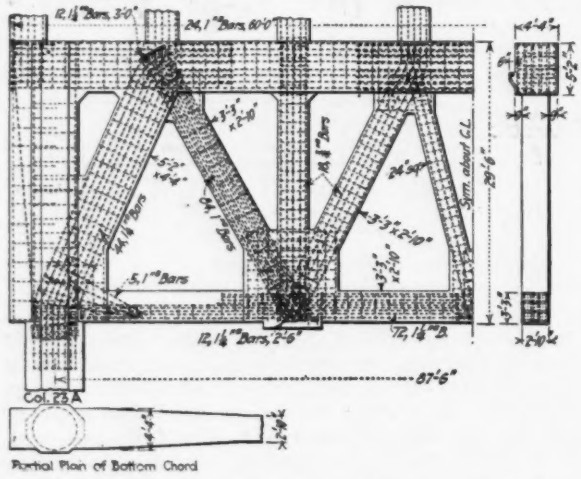
The roof trusses are 126 ft. 6 in. in span, c. to c. of columns, 15 ft. 8 in. high; each truss has 61 tons of reinforcing steel, 231 cu.yd. of concrete and carries a load of 750 tons. In the building up of these trusses the soffit of the truss, with its reversed decorative forms, was put in place first; the bottom chord steel was next laid out and fastened securely in place. Spacers made of 1¼ x 1¼-in. bars bolted together, placed approximately 10 ft. centers, were used to hold this bottom chord steel in place. Cement blocks were used to carry the load. Care was taken in placing these blocks to see that they were staggered so as to allow for the placing of the concrete. The bottom chord consists of 1¼-in. square deformed bars, 65 ft. long; a 6-ft. lap was used at the



TYPICAL REINFORCED-CONCRETE CANTILEVER GIRDER CARRYING BALCONY

splices with three ¾-in. U-clamps. Particular care was taken to see that these U-clamps were securely in place and tight. The locations of these splices were all laid out so as to stagger with the splice in the bars adjacent to them. At the ends of the truss the bottom chord bars were all hooked around the vertical column bars. Bars in the diagonal tension members were laid out so as to work in between each layer of the bottom chord. These bars were hooked on both ends with a cross-bar running through the hooks, the top chord being rectangular in shape and reinforced as for a rectangular column.

The columns along the alley which support these trusses have a double core, 36 in. in diameter, with steel



REINFORCED-CONCRETE TRUSS OVER PROSCENIUM

on the inside, figured to carry a direct load. Bars to take the bending were placed outside of the hooping and tied in, extending from the foundation to the top of the roof truss.

The huge balcony girder, which carries the four cantilever trusses, has a length of 126 ft. 6 in. c. to c. of columns; it has 570 cu.yd. of concrete and 110 tons of steel. The reinforcing steel in the bottom at the center consists of 204 1¼-in square bars. This girder was poured in one continuous run of 47 hours. The supports consist in double core columns at each end which set in between the columns carrying the roof. The ends of the girder are 6 ft. thick and 26 in. high, and at the center it is 5 ft. thick and 18 ft. 11 in. high, carrying a load of 2,000 tons. Two large holes are left through the girder for the ramp leading from the foyer to the front edge of the balcony.

The four cantilever trusses which are carried by the above girder have a maximum overhang of 43 ft., the anchor arm being 55 ft. 5 in. These trusses were cast with the large girder; the floor system was built after the forms were removed.

Some of the other structural features consist of the heavy framing over the entrance lobby with a 12-ft. reinforced-concrete marquise, extending out 12 ft. beyond the building line. This marquise is 89 ft. long, the central portion is built on a circle and faced with terra cotta, and it has a marble ceiling. The main supporting girders extend back into the building and are hung to the bottom of the girder spanning the lobby. An exit 15 ft. wide on each side at the rear of the orchestra floor was required; as the main supporting columns are only 12 ft. 6 in. centers, this required that these columns be spread and carried up about half way and then drawn in together to the 12 ft. 6 in. centers. So as to get the maximum depth of stage, the columns at the rear of the stage are bunched together at each side and support a reinforced-concrete girder which is 3 ft. 10 in. thick and 40 ft. deep, 64-ft. span with three 40-in. diameter core columns at each end. A girder of similar size is directly over the proscenium opening. In order to get a maximum height of proscenium opening a truss is placed directly back of this proscenium so as to allow for the asbestos curtain to have a maximum possible height. This truss has a span of 87 ft. 6 in. and is 29 ft. 6 in. high, and carries the ends of the girders over the stage which, in turn, carry the office portion above. It is carried at each end by a column with 54-in. core, with 52 1¼-in. vertical bars on the inside of the core, and 28 1¼-in. bars outside of the core to take care of the eccentric loading.

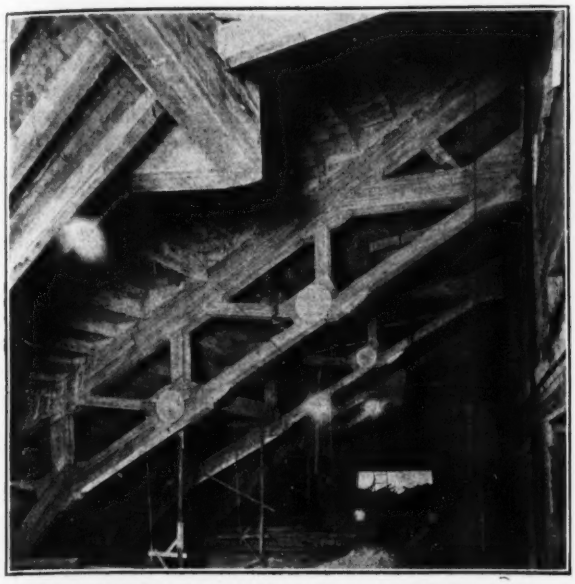
Two immense combined footings were required to support the columns which are bunched at the rear of the stage. At each side of the proscenium opening each one of these footings is approximately 56 ft. long, 9 ft. 9 in. deep, with a varying width from 24 ft. up to 35 ft. and has 156 1¼-in. bars at the top, and 460 ¾-in. square stirrups, 450 cu.yd. of concrete, and carries a load of 5,200 tons.

The footing along the alley is continuous for a length of 164 ft., the footing being an inverted tee with a maximum width of 19 ft. and 5 ft. 6 in. thick, with a distributing wall 4 ft. thick which furnishes the support for the eleven sets of double-core columns supporting the roof trusses and balcony girder.

A flat-slab floor system was used in the office wings of the building. Spacing of the columns here gives panels to which a simple flat-slab with two-way reinforcing is readily adapted. The columns are all 20 in. square and the beams of the same width and 16 in. deep, which carry a rough slab 4½ in. thick or 5½ in. from finished ceiling to finished floor.

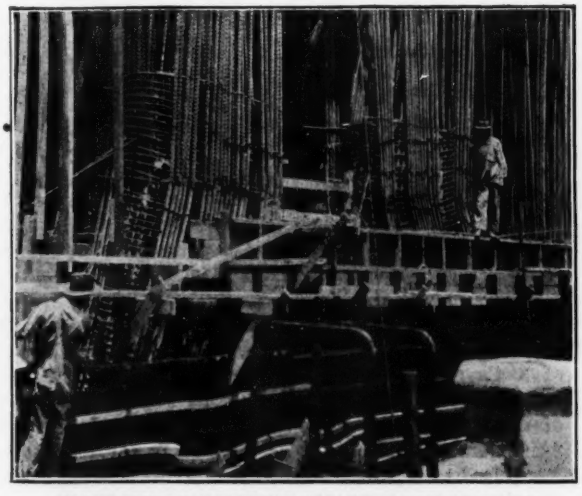
The finished walls and ceilings of the interior portion of the theater auditorium are directly on the rough concrete, using reversed forms quite freely on all the walls and soffits of the beams and cornices, leaving the concrete in its natural gray color—no attempt being made to make the concrete smooth. The ceiling decoration consists of a large round doily. Outsids of this the trusses are exposed.

Construction Details—To carry out this work there was first erected an immense falsework to support the forms for the trusses and girders over the stage and theater auditorium. (See *Engineering-News Record*, March 3, 1921.) This falsework was erected and completed before the contract for the general work on the building was let. The main procedure of construction was to erect the walls around the auditorium, stage and office portion of the building up to the bottom of the roof trusses. While this work was being done all erecting of forms and placing of reinforcing for the roof framing were being carried on and were ready for the concrete by the time the other portion of the building was built up to this point. After the roof construction was poured, the balcony girder and cantilevers were built in between the falsework supporting the roof. This was done without removing any of the falsework.



UNDERSIDE OF BALCONY SHOWING CANTILEVER TRUSS SUPPORTS

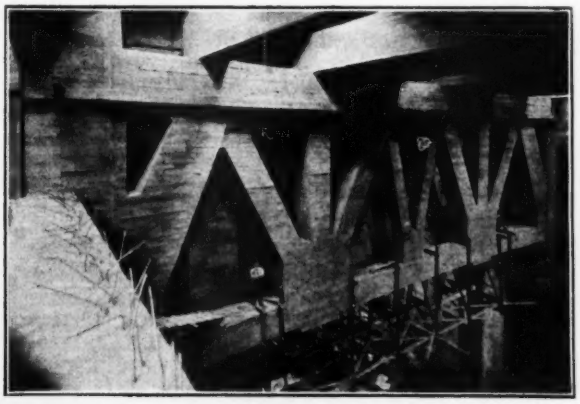
Anchor arm of cantilever shown. Length of anchor arm 55 ft. Cantilever portion of truss 43 ft. 3 in.



CLOSE-UP OF COLUMNS UNDER ROOF TRUSSES

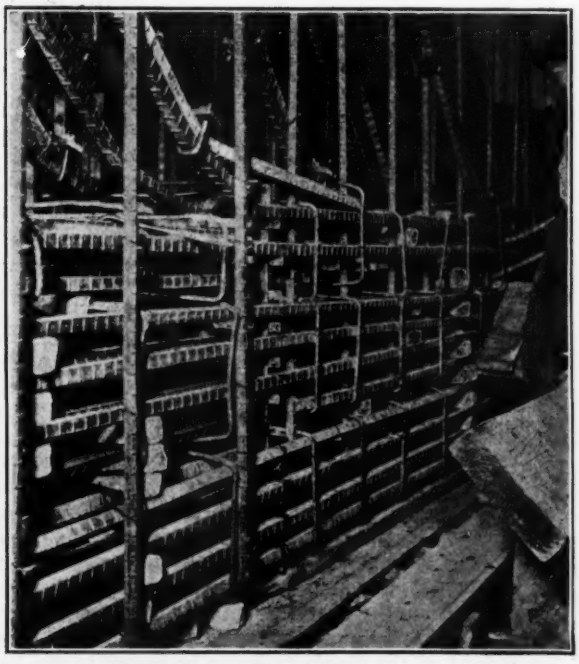
Note columns drawn together above the opening by foyer.

REINFORCING IN PLACE IN ROOF TRUSS



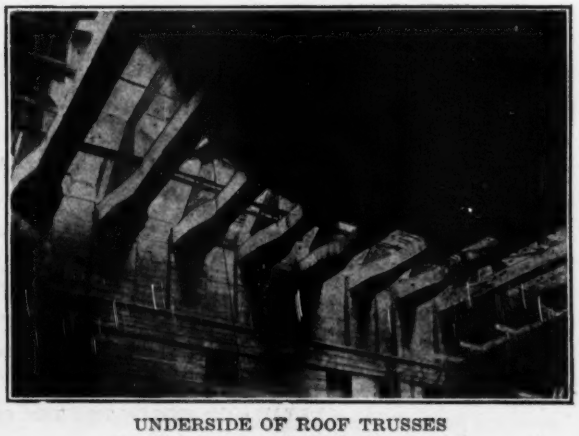
REINFORCED-CONCRETE TRUSS OVER PROSCENIUM

Span 87 ft. 6 in., height 29 ft. 6 in. Bottom chord, 34x39 in., with 72 1¼-in. bars.



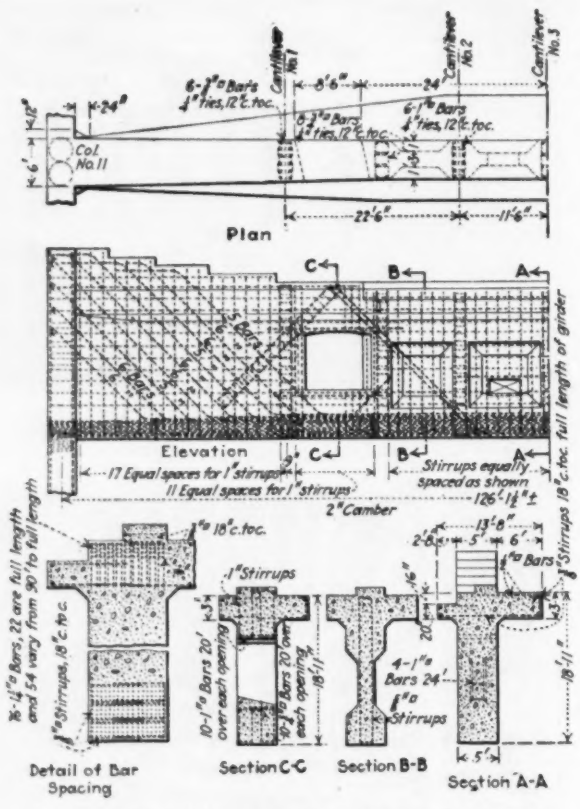
STEEL IN BOTTOM OF BALCONY GIRDER

In this lower section are 204 ¼-in. bars across a width of 5 ft. and extending up about 3 ft. Outside layer of steel is outside of part of the stirrups.



UNDERSIDE OF ROOF TRUSSES

Note the widening of chord near support.



DETAILS OF 126-FT. CONCRETE GIRDER CARRYING BALCONY CANTILEVERS

The floor system on the balcony was next placed; then the first floor in the auditorium and stage was built.

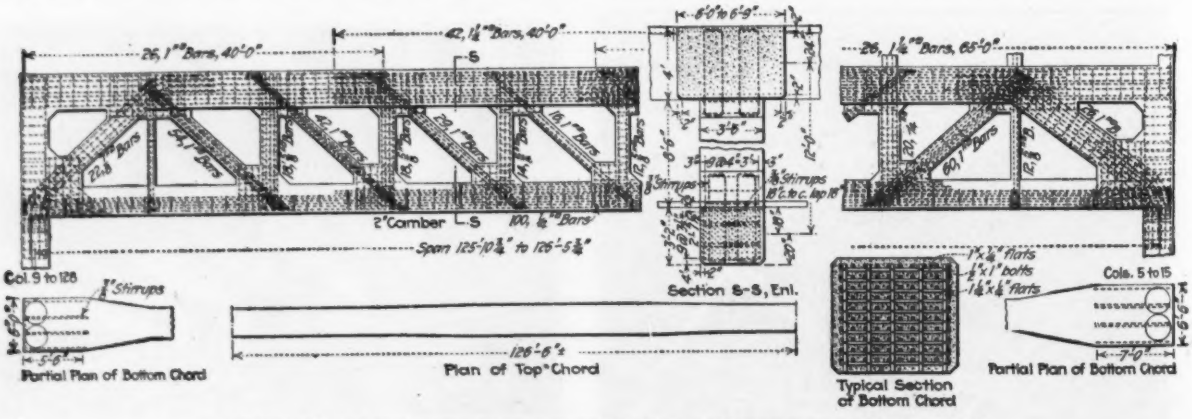
After the removal of the forms from the balcony a test was made by the city building department. This consisted in loading the entire balcony with a load equal to twice the designed live-load, which was 75 lb. per square foot. This test was made by piling a uniform load of 150 lb. per square foot consisting of earth, sand, cement and lumber over the entire balcony, equal to a load of 1,500,000 lb. This load is equal to seven times the weight of the people that can be seated in the balcony. Before this test load was placed, triggers to measure the deflection were set up at the end of each cantilever and under four points on the girder, also under the anchor arm of each cantilever. This test showed a minimum deflection of $\frac{3}{32}$ in. and a maximum deflection of $\frac{5}{64}$ in. on the four anchor arms; a minimum deflection of $\frac{3}{32}$ in. and a maximum deflection of $\frac{7}{64}$ in. in the balcony girder, and a minimum deflection of $\frac{3}{32}$ in. at the front end of the cantilevers. Close examination was made for cracks while this test load was in place but no cracks could be found at any point, and on removing the load the entire balcony came back to its original position.

The settlement and shrinkage of the falsework which supported the roof trusses up to the time of starting to pour the concrete was $\frac{3}{4}$ in. During the pouring of the bottom chord of the truss an additional settlement of $\frac{3}{4}$ in. took place. Upon removing the supports from under these trusses, after sixty days, a deflection of $\frac{7}{16}$ to $\frac{1}{2}$ in. took place; also a horizontal deflection of $\frac{1}{4}$ in. in the long columns next to the alley side.

The unit stresses used on all this work are those required by the Joint Committee on Concrete and Reinforced Concrete, 1921. No attempt was made to use any high stresses or extra mixing of the concrete, the concrete being one part of cement, two and one-half parts of washed sand and three and one-half parts of $\frac{3}{4}$-in. rock. All cement and steel were tested. All the concrete was mixed in 1-yd. batch mixers, hoisted and placed from buggies and wheelbarrows. No spouting of concrete was allowed. Particular attention was paid to the mixing of this concrete to see that it was of a consistency that would properly flow.

Two concrete mixing plants in the basement of the building consisted of storing bins, conveyors and elevators for the sand, rock and cement with a capacity to permit of pouring any two of the largest units on the building at one continuous pour without depending on material to be delivered. Extra precaution was taken so as to guard against a breakdown of this mixing plant by having duplicate parts on hand for both mixers, as well as two separate sources of electrical power.

The forms used consisted of ordinary construction of 2x4's and $\frac{3}{4}$-in. form lumber. The falsework was built up to a point approximately 4 ft. below the bottom of the trusses or girders and was then covered with a 2-in. plank floor. On top of this, 4x4's set on wedges were used to support the forms for trusses and girders. The ten trusses over the auditorium were built up in pairs. This permitted building the sides of two ad-


Partial Plan of Bottom Chord
Plan of Top Chord
Section S-S, End.
Typical Section of Bottom Chord
Partial Plan of Bottom Chord

DETAILS OF ONE OF THE TEN REINFORCED-CONCRETE ROOF TRUSSES

jacent trusses and formwork before placing the steel. A full-sized template of the trusses was first laid out on top of the falsework; boxes were made for the inside and were later put in place after the steel had been erected. The forms were allowed to remain in place for sixty days after the concrete was poured. However, a small portion at each end was taken down at the end of thirty days.

In each one of these large trusses or girders the concrete was all placed in one continuous pour. On the roof trusses each truss was poured in a continuous run of about seven hours on ten consecutive days. No attempt was made to hurry. Concreting was started by pouring the bottom chord full at one end and gradually working the concrete the full length of the bottom chord; then the diagonal members were poured and finally the top chord and roof.

The construction of the balcony girders, cantilever trusses and the framing over the stage was carried out in practically the same way as for the roof truss.

The Winter Construction Co. was the general contractor. The structural design was made by the writer in the office of Edwin Bergstrom, the architect.

Waterpower Resources of Russia Concentrated in Asia

Vast Resources in Asiatic Russia—Limited Ones in Europe—Possible Effect on Centers of Population

BY I. GUTMANN

THE COLOSSAL plans of the Soviet Government for the electrification of Russian industry and transportation through the development of the hydraulic resources of Russia cannot be studied intelligently until one has an idea of the magnitude, availability, and geographical distribution of these resources. Such detailed quantitative data are now available through their publication by Prof. A. Deysha in the *Vyestnik Inzhenyerov* of Moscow, the official organ of the "All-Russian Association (Union) of Engineers." A brief discussion of these data is believed to be timely.

The accompanying table, giving an abstract of these data, does not include streams or portions of streams which may be covered with ice more than 200 days in the year, or whose slope is less than 1 in 3,000. Catchment areas lying higher than 2,000 meters above sea level have also been excluded. The column headed "concentration" gives the minimum horsepower per square mile of contributing catchment area and serves roughly as an index of the availability and cost of development of the hydraulic energy of the basin.

For comparison, the Mississippi has a minimum of 5,500,000 hp. at a concentration of 4.5 hp. per sq.mi., the St. Lawrence, to the Canadian line, has nearly the same number of hp. at a concentration of about 18 hp. per sq.mi.; and the average "concentration" of potential power in the state of Washington is about 70 hp. per sq.mi. It should also be noted that the United States, with area only one-third that of Russia, exceeds the total potential hydraulic power of Russia by a half.

It will be observed that European Russia, which has a population of over 100,000,000, or about 80 per cent of the total population of Russia, is quite poor in hydraulic power resources. Indeed on an area which is about three-fifths of the size of the United States there is only 586,000 hp. or just about one-fiftieth of the potential water powers of the United States. The state of North Carolina has as much hydraulic energy as the whole of European Russia, California has six times as much and even Nevada and South Dakota are comparatively richer in hydraulic power resources than European Russia. The Russian territories which are rich in hydraulic power—Caucasia, south-eastern Siberia, Kamchatka, etc.—are very remote from the centers of population and industry which are in European Russia, and the power which may be developed in these territories cannot be used for the electrification of present day Russian production and transportation any more than the water powers of California and Oregon can be used for the electrification of industry and transportation in Illinois or New York.

DISTRIBUTION OF THE WATERPOWER RESOURCES OF EUROPEAN AND ASIATIC RUSSIA

Region or Basin	Concentration Hp. per Sq.Mi.	Hp.	Total Hp.
European Russia	0.26	.....	586,000
Caucasia:			7,715,000
Black Sea slope	450.00	2,285,000	.....
Northern Caucasia	106.00	3,330,000	.....
Caspian slope	54.00	400,000	.....
Southern Caucasia	23.00	1,700,000	.....
Ural	4.70	.....	923,000
Russian Turkestan:			1,550,000
Syr Darya	17.00	1,550,000	.....
Southern Siberia:			5,055,000
Irtish	8.00	725,000	.....
Yenissey		3,565,000	.....
Lena		765,000	.....
South-eastern Siberia or Amur Region:			3,130,000
Zeya	23.00	2,000,000	.....
Bureya	34.00	970,000	.....
Usury	2.10	160,000	.....
Kamchatka	21.00	.....	410,000
Total for Russia		about	20,000,000 hp.

In other words, industry and transportation in Russia proper may be electrified, by the utilization of the hydraulic resources, only to a very limited extent.

For the present at least the enormous quantities of hydro-electric energy which can be developed in Caucasia and Siberia will have to be consumed within or near the regions where they may be generated. Fortunately these regions are rich in minerals, lumber, livestock and agricultural resources, and the power developed in them may be applied to mining, manufacturing, irrigation and agriculture. Caucasia which besides its immense hydraulic resources has also rich oil fields and a wonderful climate, may rival California in its development; the Amur region in southeastern Siberia may surpass British Columbia; while southern Siberia may develop like Montana and Alberta.

These rich sections of the Russian Republic promise to become great centers of production which may bring about a shift in the centroid of population towards the periphery, southwards and eastwards—chiefly eastwards—towards the Pacific.

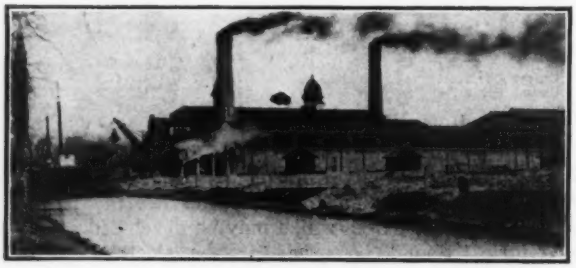
Irrigation and Drainage Have Helped Italy

In the course of a recent address on Economic Progress in Italy before the Engineer's Club of Minneapolis, Dr. Jeremiah W. Jenks, who spent six months abroad late in 1922, said: "Italy of all countries in Europe has made most progress since the war. This is especially notable in agriculture, which is now in better condition than before the war, principally because the Italian government invested in drainage and irrigation projects.

Coal Storage for Year's Supply for Detroit Water-Works

Duplicate Coal-Handling Equipment Gives Continuity of Service—Dragline Scrapers Reclaim Coal to Feed Hoppers

CONTINUITY of operation of the Detroit water-works pumping stations is assured by duplication of equipment and by summer storage of sufficient coal to last throughout the remainder of the year. Coal is purchased and shipped by water during the summer to secure an adequate supply at reasonable cost. The present installation, completed in 1922, was designed to crush and store coal in the 25,000-ton shed at the rate of 100 tons per hour and to supply intermittently any one of twelve 400-hp. horizontal water-tube boilers equipped with underfeed stokers. A crane unloads into a crusher the coal from vessels traversing 2,000 ft. of canal from the Detroit River. The crushed coal is



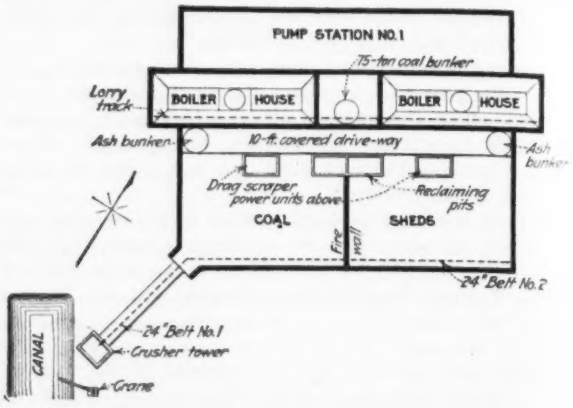
LONG LOW 25,000-TON COAL STORAGE BUILDING WITH DUPLICATE BOILER HOUSES AND STACKS IN REAR

City-owned canal for coal delivery by vessel connects with Detroit River 2,000 ft. away. Pent house over 175-ton coal bunker is just below one of the cupolas on pumping station 1. In the right rear is pumping station 2. In extreme left rear is obsolete water tower. Crane unloads coal from vessels to crusher. Inclined belt 1 (just back of smoke of crane engine) delivers to end of belt 2 running entire length of storage house.

delivered by an inclined belt to the end of a second belt conveying it the length of the storage house.

As shown in the sketch the boiler house is in effect two distinct installations, each with its own chimney, boilers, breechings, feed-water heaters and pumps. The boilers are grouped in batteries of three on either side of each of the two 150-ft. chimneys. The units are separated by two fire walls with a shop space of 20 ft. intervening. It was also considered best to keep the coal and ash-handling systems separate so that failure of one might not interfere with the functioning of the other.

The source of supply is the Toledo pool of Ohio and Pennsylvania run-of-mine bituminous coal. Barges are docked in the department's canal and unloaded by clam-shell bucket and crane. Coal is dumped into a hopper with a reciprocating feeder and crushed by a 30-in. double-roll crusher fitted with replaceable steel teeth. The hopper, crusher and lower end of a 24-in. belt conveyor together with motors and interlocking control are housed in a brick crusher tower which supports the lower end of a reinforced-concrete bridge inclosing the belt conveyor. On its journey to the storage building the coal is weighed as the belt passes over an integrating weightometer. A 24-in. horizontal belt receives the coal where it enters the building and distributes it along the south wall by means of an automatic self-propelled and reversing tripper.



RELATION OF COAL AND ASH-HANDLING EQUIPMENT TO DUPLICATE BOILER HOUSES AND PUMPING STATION 1

The coal storage building, 320 ft. long and 180 ft. wide, divided by a central cross-wall, is constructed with reinforced-concrete retaining walls for a height of 20 ft. From the top of the concrete up to the parapet is ordinary brick curtain wall construction. The entire roof area of 10-ft. span reinforced-concrete slabs is supported on a system of Pratt trusses and girder trusses. Only two concrete-incased steel columns in each half of the building obstruct the clear area. Coal is stored to a depth of 20 ft. and reclaimed by means of 1,000-lb. capacity drag scrapers. A complete scraper system with power unit is provided in each half of the building. Either scraper will store coal about as fast as delivered from the 24-in. belt, leaving the other for use in reclaiming the daily supply to hoppers installed centrally in the north side of the building. These hoppers with feeders and the boot of a bucket elevator are inclosed in a concrete pit. The coal is elevated and stored in a 19-ft. diameter cylindrical steel bunker of 175-ton capacity, located centrally between the east and west boiler house units, directly over the line of travel of the motor-driven 1-ton capacity weigh larries feeding the stoker hoppers. It is of interest to note that 20,000 tons of coal were weighed in over the weightometer during a certain period last year and that the coal weighed out on the larry scales checked this figure by less than 50 tons; the discrepancy no doubt was largely due to evaporation of the moisture.

At Detroit, under-water storage is not practicable because of the cold winters, and no other special provisions were made to prevent fires. After various schemes were considered for combatting possible fires from spontaneous combustion, it was decided that barricading the two handcar track doors and flooding the entire building with water to a depth of 4 or 5 ft. would quench any fire that a trench cut through the affected area with drag scrapers would not control.

The ash-handling equipment is designed as a separate unit for each boiler house. One unit is located at the east and one at the west end of the plant, easily accessible to motor trucks. Ashes are drawn by hand from the boiler ash pits into small 18-cu.ft. ash cars moved by one man along a 24-in. gage track and dumped into the 20-cu.ft. bucket of the skip hoist. The mechanism is operated by push-button control to elevate the bucket and discharge ashes into a 14-ft. diameter ash bunker having a capacity of 2,500 cu.ft. A balanced duplex gate in the bottom cone of the bunker, about

9 ft. from the ground level, provides for loading the ashes into a motor truck.

The installation has proved satisfactory in every way, according to the engineers. W. H. Mueller, of Detroit, executed the contract for the coal-storage building. The coal-handling equipment was installed by the Guarantee Construction Co., of New York, and the ash-handling equipment by the Palmer Bee Co., of Detroit. The design and construction of this work was carried out under the general direction of George H. Fenkell, superintendent and general manager, and Theodore A. Leisen, consulting engineer.

Planned Publicity Aids Missouri Road Program

Signs Describing Operation Placed on New Projects—Located State Routes Marked Before Road Is Improved

A NECESSARY adjunct of state road building at the present time is well organized publicity. In Missouri the State Highway Commission, realizing the necessity of gaining the confidence of the citizens in the commission, established a policy which was expressed in formal resolution "to take the people of the state into the confidence of the Commission." The result has been that the comprehensive plan of building 7,643 miles of highways in the state has withstood the onslaughts of politicians and has weathered a session

PROJECT-INFORMATION SIGN-BOARD

of the legislature which was so influenced by public sentiment that all efforts to change the state law were effectively throttled.

One of the publicity methods which has given much satisfaction throughout the state has been the erection on all large projects in the various counties of a sign-board shown by the accompanying illustration. This sign carries at the top the announcement that the project is being constructed under the direction of the Missouri State Highway Commission, followed by the statement that "Road building is a process of which the successive steps are grading, draining, constructing foundation and surfacing. After construction, systematic maintenance is essential on all types of roads." This is followed by the project number, the name of the county, the length of road to be built, the cost, the material to be used and the name of the engineer in charge and of the division engineer. This sign is erected on the right-of-way at some point along the project and may be seen by all travelers.

So far, there have been erected 100 of these large

MARKERS PLACED ON LOCATED STATE ROUTES

signs and this will be followed by the erection of another 100. It is hoped to have at least one in each of the 114 counties in the state. The experiment is not a costly one considering the value the commission believes it receives therefrom, and, since building roads is an operation of which the general public knows little in detail, the information serves a splendid purpose by keeping the entire state advised of the progress towards attaining a condition of perfection in highways.

Another essential feature of the publicity campaign is the erection of road markers upon the *designated* highways of the state. There are some 90 of these numbered routes traversing the state in both directions, with a large number of shorter stretches connecting the important primary routes. Each one of these highways carries its distinctive number. Pending the construction of all highways these markers are placed on the decided routes between the points named in the law and should the surveys and actual construction follow a different route, they will be reset after the roadway has been completed.

Another method used to enlighten citizens on the work of building roads, is the transmission at frequent intervals of short news stories to the leading weekly papers of the state. It has been found that so much interest is manifested in highway construction that the county newspaper is always anxious to secure reliable data that it can give to its subscribers. There are some 200 or more newspapers in the state that regularly print this matter which is prepared in the office of the commission by a trained newspaper man. This publicity goes into the rural communities and carries information to those places where it is, no doubt, most needed.

Tests Show High Impact on Culverts

Tests of the transmission of impact from road surfaces downward through the fill to culverts have been carried out at Iowa State College. Prof. Anson Marston states that impacts as high as 100 per cent of the static effect of the moving load may occur where the thickness of cover over the culvert does not exceed 2 ft. This experimental showing, moreover, is verified by field experience with pipe culverts under thin cover. In one case, many culverts broke under shallow fills.

Belt Line and Industry District at Flint, Mich.

Pere Marquette R.R. Builds Loop to Detour Freight Traffic and Serve Large Outlying Industries

AN 8½-mile line now nearing completion by the Pere Marquette R.R. at Flint, Mich., will not only divert through freight traffic from the main line which traverses the city but will serve also to develop a large industrial and manufacturing district established by the city. In addition, this improvement is likely to postpone indefinitely a move for the more expensive work of elevating the main line in order to eliminate street crossings at grade, since it is the freight trains which are the main cause of complaint in obstructing traffic.

From Fig. 1 it will be seen that the main line runs practically north and south in a wide loop through the city, and near the center of the business section it has a grade crossing with the Grand Trunk Ry. The Detroit United Electric Ry. operates an interurban passenger and freight service through the city. All these lines are at street grade. About twenty years ago the Grand Trunk Ry. built a freight loop or belt line which runs south of the central portion of the city and thus keeps its through traffic away from the business district. In recent years, however, the city has been built up to this line. On the Pere Marquette R.R. there are about eight passenger trains daily, but the interruption to street traffic comes mainly from the long and heavy freight trains moving at slow speed. Fire equipment has been halted occasionally in this way, with consequent public complaint and demand for grade separation.

A project for an east side industrial district with railway communication, in order to provide systematically for the commercial expansion of the city, was included in a report made to the City Plan Commission in 1917, by Bion J. Arnold, consulting engineer, Chicago, and John Nolen, city planning expert, Boston. For railway service it was proposed to have a municipal line extended through this district, to be operated either by the city or by some connecting line under lease, with the provision that free use of the line should be accorded to all railways entering the city. Track elevation and a union passenger station for steam railways and electric interurban lines, were included in the suggested improvement, but it was shown that the diversion of freight traffic from city streets was of more immediate importance.

War conditions delayed the proposed development, but in 1921 the Chamber of Commerce agitated the matter, the city limits were extended north and east, an area of about 1,000 acres within the new eastern limits was secured by local interests for the industrial district, and a right-of-way for an 8½-mile belt line was also obtained. Negotiations for the construction and operation of this line were entered into with the Pere Marquette R.R. and that company offered to undertake the work if the right-of-way was provided. The necessary land was then donated to that company with the understanding that the trackage would be available for any railroad which might desire to use it. Later, however, the railway company bought the line for use as a freight cut-off. The company will operate all industrial switching movements and will provide for interchange with other roads. A structural steel plant and two or three automobile plants have been erected already in the industrial district.

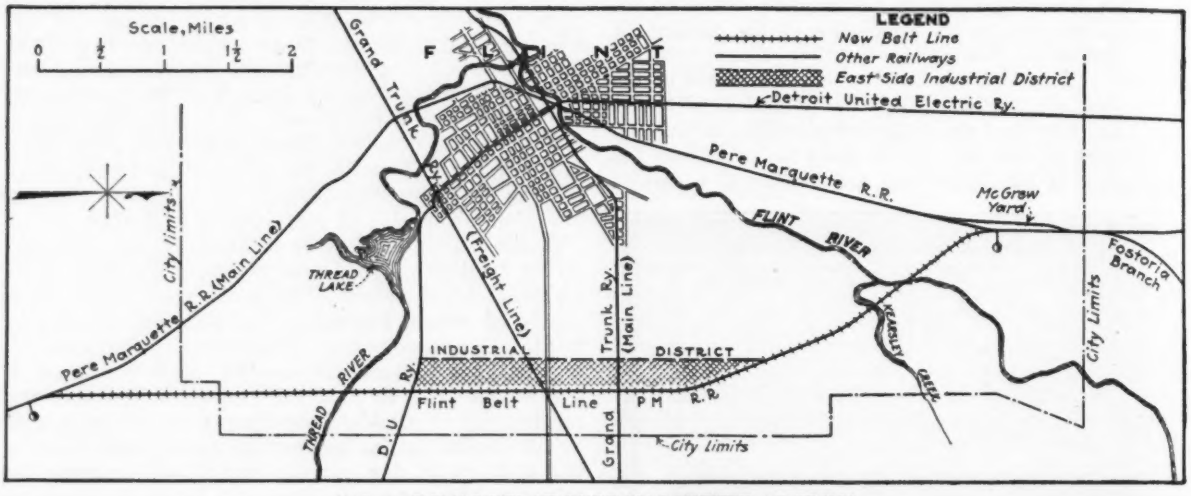


FIG. 1—BELT LINE OF PERE MARQUETTE AT FLINT

For the first five miles of the belt line the earthwork is light, but for 3½ miles at the north end it is much heavier, the line crossing the Flint River valley and ascending to a higher plateau. Two long fills of about 130,000 cu.yd. on the south and 50,000 cu.yd. on the north form the approaches to the Flint River bridge. The total excavation on the line is about 280,000 cu.yd. A roadbed width of 20 ft. is given on fills and 24 ft. on cuts. In fills the quantity is increased by raising 10 per cent above subgrade to allow for settlement and subsidence. The maximum grade is 0.3 per cent and the sharpest curves are of two degrees.

Track is laid with 90-lb. rails on hardwood ties treated by the zinc-creosote process. Interlocking plants will be provided at the intersections of the Grand Trunk Ry. and the Detroit United Ry. At the north end of the line is the McGrew yard, where cars to and from local points and the industrial district are cut out and assembled.

In making the large fills, framed bents were used for the temporary trestles as it was cheaper to buy timber than to drive piles. Filling was handled by 8-car

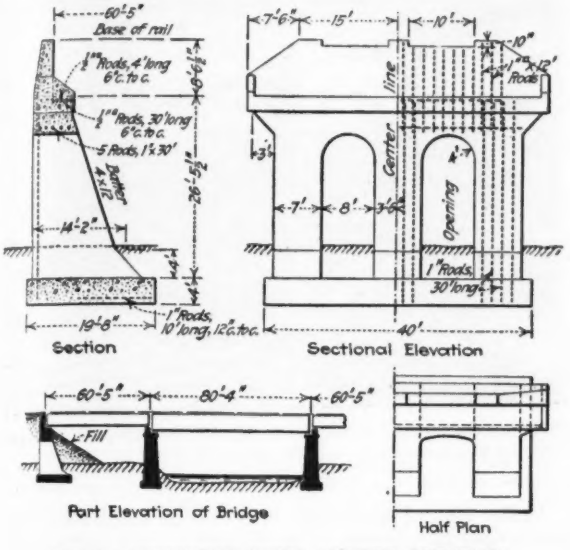


FIG. 2—ABUTMENT WITH ARCHED OPENINGS

trains of gondola cars having the sides formed by panels hinged at the top, these cars averaging loads of 25 cu.yd. When the train reached a fill, with the locomotive and unloader car at the rear end, a car with unloader plow in place was coupled to the head end. The hook of the plow cable on the drum in the rear car was then attached to a derrick beside the track and the train pulled ahead until the cable was strung along the train and hooked to the plow on the head car. The train was then backed down onto the trestle and the unloader engine hauled the plow through the cars, men keeping ahead of it to release the latches of the side doors. When the empty train had pulled off the trestle, the car with plow (next to the unloader car) was cut off and left to be attached to the head of the next train.

The two principal bridges are those over the Flint River and Kearsley Creek (Fig. 2), both of which are plate girder structures on concrete piers and abutments. The former has two 70-ft. spans and the latter has one 80-ft. and two 60-ft. spans. The abutments are of very heavy design and have arched openings so that the end slope of the fill extends through the abutment, which is thus largely embedded in the earth so that the pressure against it is equalized. Under the surface sand and clay is a deep bed of hard blue clay in which foundation piles could not be driven and it was even difficult to drive sharpened sheet piles for the cofferdams. The piers were built in this clay and built up as concrete monoliths. All foundations and substructures are built for double track, with single track spans at present. All bridges of the line are designed for Cooper's E-60 loading.

The Dominion Construction Co., Niles, Mich., has the contract for the entire line and has operated a force of about a hundred men, working 10-hour days and accommodated in two camps. The line was laid out and built under the direction of A. L. Grandy, chief engineer (now assistant to president and general manager), Pere Marquette R.R., and J. Tuthill, assistant chief engineer, with Frank Manning as resident engineer in charge. The total cost will be about $800,000 and it is expected to have the line completed by the summer of 1923.

Tests a New Locomotive Booster

AN EXPERIMENT of particular interest to railway mechanical men, and of general interest to all engineers interested in railroad operation, is now being carried on by the Delaware & Hudson Ry. on its Susquehanna division. It consists in the trial of a new type of booster for use on the tenders of locomotives, known as the M. & L. booster. Heretofore the only boosters in actual operation were installed as trailers on the locomotives. There are at present about 1,000 of this type in use, some of them for nearly three years.

On June 5 the D. & H. company gave a demonstration of their new booster in actual operation over a section of track between Central Bridge and Delanson, a distance of 9.5 miles and up an 0.8 per cent compensated grade 5⅛ miles long. An inspection train was run on a track parallel to the one on which the locomotive with the new booster was operating, so that it was possible at all times to observe its performance.

The locomotive was a consolidation type with a rating of 1885 adjusted tons. For the purpose of this test the rating was increased by 591 tons, or 31.35 per cent, a total of 36 loaded cars. To demonstrate the capacity of the locomotive the train was stopped on the middle of the hill. Without the booster the locomotive could not start the train, but when it was cut in the train was started again without difficulty.

This booster was designed by Col. J. T. Loree, general manager, and Maj. J. A. McGrew, general superintendent of equipment, both of the Delaware & Hudson Co. It consists of a simple two-cylinder engine with 12 x 10-in. cylinders geared to the rear axle of a pedestal type four-wheel truck of the locomotive tender. Power is transmitted to the forward axle of the truck by side rods. The engine is so arranged that it can be thrown into mesh by a bell crank operated by a piston impelled by steam from the line supplying the booster engine.

The advantage of this type of booster over the type now in general use on locomotives is that it makes use of the weight of the tender in gaining tractive effort, and does not increase the weight of the locomotive. This feature is of particular advantage on lines where the concentrated weight of the locomotive has about reached the carrying capacity of some of the bridges. It is lighter in weight, and has developed a higher efficiency by about 15 per cent than most of the boosters now in operation.

The first booster of this type constructed under the patent of Messrs. Loree and McGrew was made at the D. & H. shops. The booster tested on June 5 was manufactured under the same patent by the Baker Manufacturing Co. of Saratoga Springs. The D. & H. company considers that this booster has gotten beyond the experimental stage, and it is reported to have placed an order with the Baker Manufacturing Co. for 100 more.

Typhoid Fever a Compensable Accident

Typhoid fever contracted by a hotel employee "as the result of drinking impure well water furnished by the hotel," states *Public Health Reports* for June 8, 1923, "has been held compensable as an accident within the meaning of the Workmen's Compensation Act by the Supreme Court of Michigan." (Frankamp *v.* Fordney Hotel et al., 193 N. W. 204.)

Revolving Screens for Low-Lift Pumping Station, Detroit Filters

Primary Mission to Intercept Floating and Slush Ice—Adhering Matter Flushed Into Trough Leading to Sewer

By Theodore A. Leisen
Consulting Engineer, Department of Water Supply, Detroit, Mich.

IN THE OPERATION of the new Detroit filtration plant (see *Engineering News-Record*, May 17, p. 860) the water will be raised from 25 to 30 ft. for delivery to the coagulation basins. The low-lift pumping station, constructed for this purpose, is equipped with five electrically-operated centrifugal pumps, and one of the factors of special interest in this station is the system of revolving screens which intercept the water before it reaches the pumps.

The water from the Detroit River is conveyed to the station through a 10-ft. tunnel and conduit, and at the southerly or influent end of the station it enters a chamber 31 ft. wide by 59 ft. long, the bottom of which

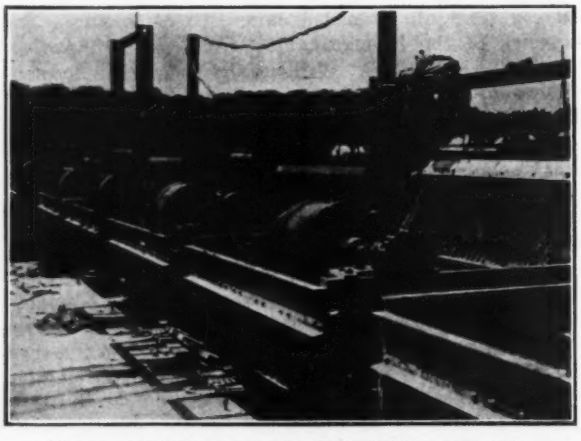


FIG. 1—INTAKE SIDE OF REVOLVING SCREENS
Each set is operated by separate 5-hp. motor.

is slightly lower than the invert of the tunnel, and about 35 ft. below the surface of the ground. The screens are in a perpendicular plane, centrally located across this chamber on its longer axis. Beyond the screen chamber a suction well 11 ft. deep and 26 ft. wide extends for the full length of the station, with the pumps located on the floor immediately above this suction well or conduit.

There are seven sets of revolving screens, operated by a separate 5-hp. electric motor, providing a speed of 10 ft. per minute. Each screen consists of thirty-eight panels 24 in. wide by 72 in. long, interlocking along the upper and lower edges, and in close contact at the ends with the stationary guides. The panel frames are made of 2x2-in. steel angles with a 3-in. projecting lip or bucket at the bottom upstream face of each panel. The screening element, which is bolted to the panel frames, consists of 14-gage copper wire, three meshes to the inch, making the net openings approximately ¼ in. square. These panels are secured to endless link chains revolving around upper and lower sets of sprocket wheels, with the lower end passing through a special shoe and the upper end projecting 6 ft. above the operating floor, the total distance between upper and lower sprocket-wheel shafts being 31 ft.

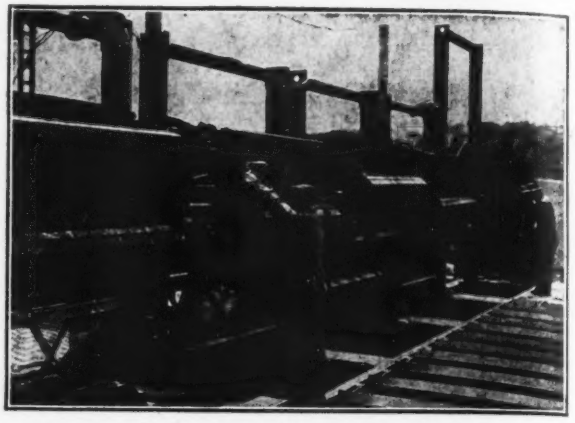


FIG. 2—DISCHARGE SIDE OF SCREENS DURING ERECTION
The ¼-in. mesh screen panels are 2 ft. wide by 6 ft. long and the total opening interposed across the screen chamber is six times the area of the inlet tunnel.

Under normal conditions of operation the screens are submerged to a depth of 24 ft., and the net water area of openings in the seven sets of screens is approximately 500 sq.ft. or over six times the cross-sectional area of the intake tunnel, resulting in a very low velocity in the passage of the water through the screens.

The primary mission of the screens was to intercept all floating or slush ice coming through the tunnel, and to prevent the permanent formation of frazil or needle ice on the surface of the screens, but incidentally they serve also to prevent the passage of fish and all floating débris. All material adhering to the face of the screens or caught on the projecting lip or bucket is washed off by means of a water spray. A perforated pipe placed back of the screen below the upper sprocket wheel, where the downward passage begins, supplied by water under 60-lb. pressure, washes all adhering matter off into a trough connected to a sewer. Warm water and steam are provided for use in the event of persistent ice formation.

The screens, which were built by the Link-Belt Co., were in use throughout the past winter, proving entirely satisfactory and clearly demonstrating their value.

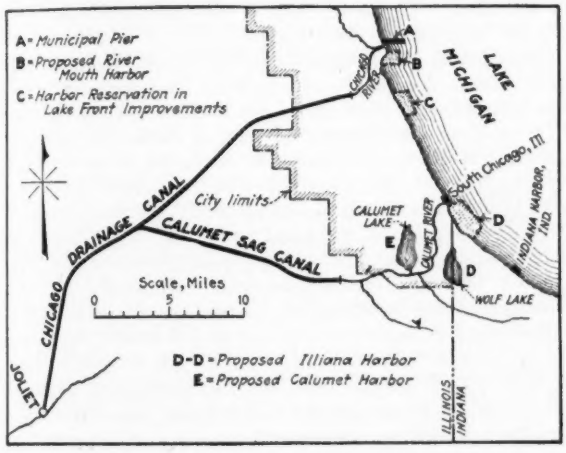
Canadian Good Roads Association Meets

The tenth annual convention of the Canadian Good Roads Association was held at the Royal Connaught Hotel, Hamilton, Ont., June 11-13 with a large attendance of delegates representing every province of Canada, and including many cabinet ministers. Among the more prominent of those who delivered addresses or read papers were Hon. J. L. Perron, Minister of Roads for Quebec Province; Hon. H. Cockshutt, Lieut. Governor of Ontario; Hon. E. H. Armstrong, Premier of Nova Scotia; Hon. F. C. Biggs, Minister of Public Works for Ontario; Hon. J. D. MacLean, Provincial Secretary of British Columbia; D. M. Hill, Provincial Highway Engineer for New Brunswick; Hon. J. P. Veniot, Premier of New Brunswick, and A. W. Campbell, Dominion Commissioner of Highways. Strong appeals were made for a continuance of federal aid in highway construction. The following officers were elected: honorary president, Hon. J. L. Perron, Quebec; president, Russell T. Kelley, Hamilton; first vice-president, Hon. Frank C. Biggs, Ontario; second vice-president, A. McGillivray, Manitoba; secretary-treasurer, George McNamee, Montreal.

Calumet Harbor Advocated for Chicago

THE Interstate Harbor Commission organized by the states of Illinois and Indiana to report upon the so-called "Illiana" project for a harbor on Lake Michigan at the state line and also utilizing Wolf Lake, has reported adversely to this project. In view of the large areas of undeveloped harbor sites, the uncertainty of early development of the St. Lawrence waterway and the enormous cost of $400,000,000 estimated for the Illiana harbor, it is recommended that no further action be taken at this time, but that the waters of Wolf Lake be retained for possible further use. On the other hand, the development of a harbor in Lake Calumet is recommended, as approved by the War Department.

A general review of the Chicago harbor and waterway situation is given in the commission's report, and is explained by the accompanying map. It is pointed out that the Great Lakes and St. Lawrence waterway



HARBOR PROJECTS IN CHICAGO DISTRICT

project is only in its preliminary stages but that there is no adequate accommodation for such vessels as are expected to reach Lake Michigan if, and when, this waterway is completed. On the other hand, it is planned to have the Illinois link in the Lake and Gulf waterway completed in five years, but this will be for barge traffic and not for large steamers. Closing the Chicago River to all navigation is not approved, since the commission considers a local harbor desirable at the mouth of the river, with barge service to industries along the river. Further, barge navigation in connection with the Lake and Gulf waterway "can be provided through the Chicago River cheaper than through the Calumet River." Under this plan drawbridges would not be needed.

As a result of its study the commission has made the following recommendations and states that the proposed developments together with existing facilities will serve for many years:

1. Development of facilities along the mouth of the Chicago River to serve the city's commercial district.
2. Development of harbor facilities along both branches of the Chicago River for barge transportation in connection with the Lakes and Gulf waterway.
3. Development of the harbor facilities of the Calumet River for industrial purposes.
4. Improvement and development of Calumet Lake as an industrial and transfer harbor, having adequate connections with Lake Michigan and the Calumet-Sag canal.
5. Development and use of the unoccupied lands inland from Indiana Harbor, Ind.
6. Improvement of the Little Calumet River and the Calumet-Sag canal of the Sanitary District of Chicago as demands may require.
7. All terminal developments and operations to be under the supervision of the Illinois Division of Waterways and some appropriate state agency for Indiana.

Boston Metropolitan Planning Commission Created

A DIVISION of Metropolitan Planning within the Metropolitan District Commission of Massachusetts is created by Chap. 339 Acts of 1923 of that state. The commission has comprehensive duties in the way of investigations, reports and advice on transportation in all its phases and in its various relations to local and metropolitan planning.

The commission is to consist of seven members of whom three, to serve without pay, are to be appointed by the Governor, with the approval of the Council, for five-year terms, while one is to be an associate commissioner of the Metropolitan District Commission (which now has charge of water supply, sewerage and parks of the Metropolitan District); one a commissioner of the Transit Department of the City of Boston; one an associate commissioner of the State Department of Public Works (which has charge of highways, waterways and lands), and one a commissioner of the Department of Public Utilities. Each of the four ex-officio members is to be designated by the head of his department. The chairman of the division is to be named by the governor. The division is required to report annually to the Legislature and to submit annually to the budget commissioner an estimate of its expenses for the ensuing year. This estimate is limited to $25,000 annually and is subject to legislative approval.

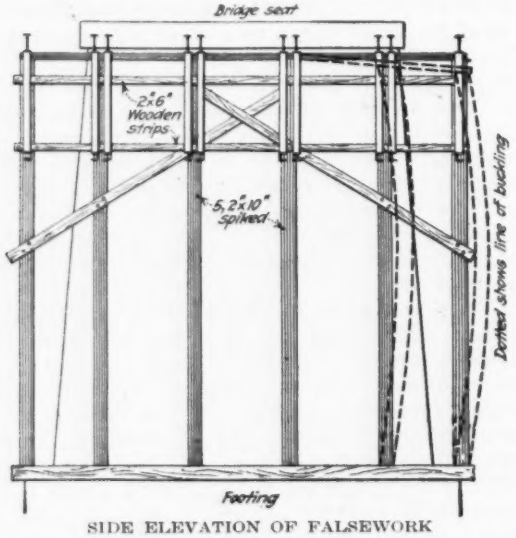
The section of the act stating various duties follows:

Said division shall investigate transportation service and facilities within the metropolitan district, which shall consist of all the cities and towns in either of the metropolitan sewer districts, the metropolitan water district or the metropolitan parks district, and the co-ordination thereof upon highways, roads, bridges, waterways, railroads, street railways and other arteries of traffic; what, if any, use of existing facilities of carriers by one or more of such methods can and should be made by others; the manner of effecting such co-relationship and what improvements and new facilities should be provided for a comprehensive and co-ordinated development of transportation for said district; and the relation of such service to the general service rendered by all highways, roads, bridges, waterways, railroads, street railways and other arteries of traffic in the commonwealth so far as the division deems it necessary or desirable. It shall confer with the local planning agencies in the district with regard to such projects as are not of an exclusively local character. It shall recommend the method of executing and paying for the same, and shall make such maps, plans and estimates of cost as may be needed for its investigations and reports, and may employ such assistants thereior as it deems necessary. The various other departments, boards, and divisions of the commonwealth, the public trustees, respectively, of the Boston Elevated Railway Co. and of the Eastern Massachusetts Street Railway Co., the street commissioners, planning boards and other officials of cities and towns comprising said district, and the various public utilities operating therein may, and upon request of the division shall, consult with it and furnish all facts and information requested within their knowledge and control.

Tall Unbraced Timber Posts Cause Falsework Failure

Built-Up Columns, Made of Five Thicknesses of 2 x 10-In. Planks, Buckle When Concrete Pouring Is Under Way

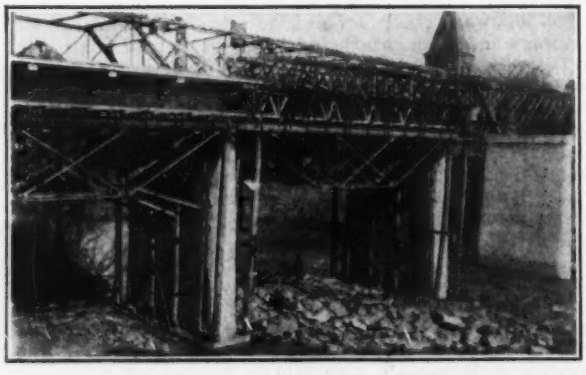
FAILURE of falsework due to the buckling of unbraced, built-up timber posts in a bent carrying one end of truss supports for the deck and girder forms of a concrete road bridge span was recently the cause of a serious accident in building an eight-span bridge across the Haw River in North Carolina. A 50-ft. span being concreted fell into the river carrying with it and injuring several workmen. Investigation disclosed that the contractor had used 30-ft. posts in the bents supporting the trusses, had built the posts of short



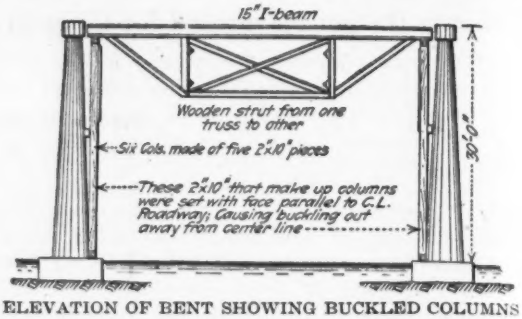
SIDE ELEVATION OF FALSEWORK

planks spiked together and had used no bracing between posts. The sketches indicate where it failed.

As stated, the bridge had eight spans. All were 50-ft. deck-girder spans with a 20-ft. roadway and two 5-ft. sidewalks. The spans were reinforced and so were the abutments, but the simple slab piers, indicated by the view, were plain concrete. I-beams trussed as shown carried the deck forms and were braced together across the span by 2x6-in. planks. The ends of the trusses rested on the caps of timber bents set close against the piers and on the pier footings. In the span



BUCKLED POSTS OF FALSEWORK BENT


15" I-beam
Wooden strut from one truss to other
Six Cols. made of five 2"x10" pieces
These 2"x10" that make up columns were set with face parallel to C.L. Roadway; Causing buckling out away from center line
30'-0"

ELEVATION OF BENT SHOWING BUCKLED COLUMNS

which failed the posts of the bents were approximately 30 ft. long and were made up of five thicknesses of 2x10-in. plank spiked together. The planks composing the posts were less than full length but they had been spiked with staggered joints. The posts were set with the 10-in. sides of the planks parallel with the length of the span. Originally there was, between cap and sill, no bracing between posts.

Buckling of the composite columns was first noticed after about 25 cu.yd. of concrete had been poured. The two outer columns of a bent buckled outward about 2 ft. causing a settlement of some 3 in. in the outside trusses. Work was stopped and the forms were brought back to line by adjusting the wedges. Also the posts were braced by spiking to them 2x10-in. plank diagonals. Pouring concrete was resumed but after about 75 cu.yd. were in place additional buckling was noticed and within a short time the entire falsework collapsed. It was evident that the buckling of the two outer posts caused a downward deflection of the cap which threw the outer trusses out of plumb thus bringing an eccentric load on them which caused failure. The remaining trusses were carried along in the collapse by the horizontal bracing connecting the trusses.

Standard Signs for Mississippi Valley State Roads

ADOPTION of standard caution and guide signs and other safety devices on highways in the Middle West States has been recommended by the Mississippi Valley Asociation of State Highway Officials. The Minnesota Highway Department states that it will follow the recommendations as closely as possible, particularly that portion with reference to shape. Old signs are not to be destroyed but when new ones are erected they shall conform.

Some of the recommendations are as follows: Route marks are to include road numbers and be of the distinguishing symbol characteristic of each state. All warning signs shall be uniform in all states and guide and information signs as uniform as possible. Warning and guide signs are to be black and white. Warning signs are not to be placed at too frequent intervals because the public then discredits their value. The location is to be 3 and 4 ft. above the center of the road, 1 ft. outside of the outer shoulder line and 300 to 500 ft. back from the danger point. Round signs 2 ft. in diameter indicate railroad crossings; octagonal, 2 ft. across, stop; diamond, 2 ft. square, slow, and square, 2 ft. caution. The stop sign should be located in the center of the road. Guide signs are to be rectangular and of suitable size to accommodate the information. Advertising signs on right-of-way or pavement are forbidden.

Predicting Next Year's Rainfall for Southern California

Scientists Attempt Basis for Long-Range Seasonal Forecasts by Study of Ocean Currents and Atmospheric Pressures

By Paul A. Ewing
Oakland, Calif.

Table copied and text rewritten from official publication of San Diego County Farm Bureau.

URGED by the constantly growing seriousness of the water scarcity, scientists in Southern California have finally evolved a system of long-range rainfall forecasting which promises eventually to establish a basis for anticipating, with a fair degree of certainty, seasonal precipitation for the California coastal region or for any other section whose climate is similarly affected by ocean currents and the distribution of atmospheric pressures. Particular attention has been directed to the possibility of seasonal forecasts by western meteorologists for many years past, the need for such anticipatory knowledge being of great importance there on account of the rapid expansion of irrigation and power developments having a close dependence on rainfall. The influence of sun-spots has been much discussed, and even the growth of rings of trees has been studied to obtain seasonal variations of weather. The close relation of weather to barometric pressures has been the basis of the studies conducted by Scripps Institution of Biological Research, at La Jolla, Calif., and it is upon the accumulating results of these observations that present hopes of California agriculturists and hydro-electricians are centering.

While the scientists of Scripps Institution who have had this work in hand are not yet willing to assert that dependence may be placed upon forecasts based on their records, on account of the comparatively short period covered, they have been much encouraged by successful forecasts of the monsoon rainfall of India, months in advance, which were based upon observations of atmospheric pressure distributions over vast areas of land and water. Prof. George F. McEwen, in charge of the forecasting studies at La Jolla, has now a six-years' record of ocean temperatures for a ten-weeks' period each year, and the seasonal rainfall observed at six inland recording stations following the date to which the summer temperature corresponds. The computed rainfall and that actually observed during the six years recorded are in no case far apart.

Recording Stations—Six stations were selected in two groups of three each, Bonita, San Diego and Escondido representing the coastal region of San Diego County, and Tustin, Corona and Los Angeles being assumed to be representative of the northern part of Southern California. The average rainfall of all six stations was considered as representing the general coastal region of Southern California. In tabulating the data secured so far and computing the values of the seasonal rainfall from temperature observations, it was assumed that the departure of the temperature at any season from the average during the period of observations is proportional to the departure of the subsequent seasonal rainfall from its average value. The temperature departure multiplied by the constant factor 2.4 gives the computed rainfall departure. This is shown in the accompanying table, prepared by Prof. McEwen.

As explained by Prof. McEwen, the general atmospheric circulation between equatorial and polar regions brings about the high barometric pressure in the belt centered near the parallel of 35° N, the lower air of the equatorial region forming the west-bound trade winds, and that north of the parallel forming the westerlies. The deflecting force of the earth's rotation, acting to the right, forces the two oppositely-flowing currents of wind together, compressing the air between, and so forming the high-pressure belt; and the smooth surface of the ocean permits a higher wind velocity than does the land, so that the barometric pressure is greatest at sea. To all this is added the thermal effect due to the difference in radiation and evaporation from the land and water surfaces, which makes the land in the high-pressure belt colder than the water in winter and warmer in summer. In the latter season thermal dynamic causes together develop and maintain the belt of high pressure, but with the approach of winter the air flows landward in response to changing temperature relations. By mid-winter the dynamic causes have the upper hand and a land "high" is developed by the transfer of a great mass of air from the ocean to the continent. The fact that the probable amount of this air movement could be estimated if detailed measurements of the pressure distribution over the North Pacific were available was what suggested the possibility of forecasting the consequent seasonal rainfall from pressure observations made during the summer.

Theory Stated—The practical impossibility of securing such observations in sufficient number would have prevented use of the idea; but the known relationship between pressures and surface ocean temperatures off the coast of California still permitted the study to proceed. Briefly, the theory is that the lower the surface ocean temperature, the greater the intensity of the ocean "high" and the heavier the consequent seasonal coastal rainfall. The results of daily surface temperature observations at Institution Pier, La Jolla, agree with this inferred correlation between temperature and rainfall, showing that a fall of one degree in temperature corresponds approximately with an increase of about 2 in. in the subsequent seasonal rainfall. Prof. McEwen refers to the results obtained so far as "the first crude approximation to the lengthy and detailed investigation that should be made." The studies are being continued and extended, with the idea that a long record may eventually permit accurate predictions of the rainfall many months in advance, to the very considerable benefit of agricultural and industrial interests of the southern part of California.

Year	Ocean Temp. at Institution Pier for Ten Weeks Aug. 1 to Oct. 15, Deg. F.*		Seasonal Rainfall† Following Date to which the Summer Temperature Corresponds.* Bonita San Diego Escondido		Tustin Corona Los Angeles		Mean of All Six Stations		Computed Departure From 6-Year Seasonal Mean
1916–17.....	66.4	—1.2	12.8	+0.2	13.0	—0.2	12.9	0.0	+2.9
1917–18.....	68.8	+1.2	10.0	—2.6	11.7	—1.5	10.9	—2.0	—2.9
1918–19.....	69.3	+1.7	9.6	—3.0	8.1	—5.1	8.9	—4.0	—4.1
1919–20.....	66.7	—0.9	11.7	—0.9	12.6	—0.6	12.2	—0.7	+2.2
1920–21.....	67.8	+0.2	9.2	—3.4	12.5	—0.7	10.8	—2.1	—0.5
1921–22.....	66.3	—1.2	22.3	+9.7	21.0	+7.8	21.7	+8.8	+2.9
Means.....	67.6		12.6		13.2		12.9		
1922–23.....	67.8								—0.5

* First of each pair of columns gives actual figure for the period indicated, while second column of the pair gives departure from 6-yr. mean.

† The seasonal rainfall is for the year beginning July 1 of the year at the extreme left.

Self-Contained Steam Railway Coaches

A new type of self-contained, steam-driven railway coach has been developed for use on British railways. The coach is known as the Sentinel steam railway coach and is capable of developing a speed up to 50 m.p.h. It is remarkable in that while the average weight of the present steam railway coaches is over 40 tons, or about 1,650 lb. per passenger carried, the new coach as designed for standard-gage railway weighs less than 500 lb. per passenger carried. Similarly, the fuel consumption of the heavy type of coaches is approximately 25 lb. of coal as against 4 lb. per mile for the new Sentinel car, and the water consumption is 15 gal. as against 2½ gal. per mile. The boiler of the Sentinel coach is designed to operate with either coal, coke, charcoal, wood, or waste vegetable products, and therefore is capable of being operated in almost any locality. The light weight of the car makes it possible to operate it over railways that on account of light track or bridges are incapable of carrying the heavy railway coaches.

Ice House Wrecked by Overturning Ice Due to Flood

By Charles W. Lusk
City Engineer, Arkansas City, Kan.

On JUNE 10 flood waters of the Arkansas River descended upon Arkansas City, Kan., setting a new high-water mark 8 ft. above all previous levels. More than a third of the residential section of the town and part of the business section were covered with water 2 to 15 ft. deep. Thousands were driven from their homes, and the property loss has been estimated in the millions. In this flood a new ice storage house was wrecked in remarkable manner; it constitutes one of the largest single losses.

Last year the Arkansas City Ice and Cold Storage Co. completed construction of one of the most modern ice manufacturing plants in the middle west, which supplies

CONCRETE ICE HOUSE WRECKED
Flood waters melted lower layers of ice causing pile to overturn.

ice for refrigerator cars on the A. T. & S. F. Ry. from Kansas City to Fort Worth. This 10,000-ton season storage house was valued at $165,000. It was practically demolished by the melting and overturning of the pile of 40,000 300-lb. cakes of ice stored in it.

The building, which is 50 x 100 ft. in plan, rests on a foundation 4 x 4 ft. running entirely around the four walls. The floor is a 3-ft. cinder fill on the ground surface, with 10 x 14-in. timber stringers and 2 x 10-in. timber flooring. The walls are 9-in. reinforced-concrete slabs 50 ft. high, with 2-ft. square pilasters 16 ft. on centers, and 2-ft. square reinforced belt courses at the base, the middle height and the top. The walls inside the concrete slabs consisted of a 13-in. space filled with mill shavings, and twolayers of 1 x 8 -in. shiplap siding with tarred paper lining. The roof was constructed of steel girders 16 ft. on centers, 2 x 10-in. timber stringers, two courses of 1 x 12-in, sheathing with paper lining, and three layers of 2-in. cork insulation laid in asphalt, covered with three-ply asphalt roofing. From the roof were suspended four series of cooling coils containing 22,000 ft. of 2-in. wrought pipe.

At the time of the flood the storage house contained some 6,000 tons of season storage ice, piled regularly with about 4 ft. clearance around all walls. The flood waters, rising 7 to 8 ft. above the floor level of the building, filtered in through the door openings and partially melted the lower tiers of ice cakes. The entire mass of ice tipped against the east longitudinal wall and forced it outward, permitting the roof to sag to the ice pile. The foundations, parts of three walls and the floor are still intact, but the roof, the cooling system and one wall are completely wrecked. Except for 200 tons salvaged, the 6,000 tons of ice, valued at $36,000, were lost.

The company has other storage of 1,000 tons capacity that was not damaged by the flood, and by July will be turning out ice at the rate of 120 tons daily, so that all demands will easily be met. Rebuilding of the damaged storage house will be started late this year.

British Experiments With Rubber Paving

London Correspondence

RUBBER in several forms is being tested for street pavement in London, England. In one instance the rubber was laid in a business thoroughfare, carrying a traffic of 240 tons per yard width per hour. The section paved varies from three to five yards in width between the curb and tramway margin on one side of the road only, and is fairly level. Two types were laid: (1) 9x3x¼-in. rubber, vulcanized on expanded metal and anchored to concrete. The area laid was 161 super yards. This has had two years' wear. (2) 8x4x4-in. composite blocks laid on concrete foundation, similar to wood blocks; area laid, 20 sq.yd. This has had one or two months' wear.

This work was carried out in December, 1920, and January, 1923. The foundation consists of 6-in. to 9-in. reinforced concrete, and the price of the paving (including cost of foundation and estimated cost of rubber blocks) is about £5 per sq.yd. The rubber was supplied free to the council, who laid the paving with direct labor. The engineer states that in his opinion rubber has proved to be a most suitable material for road paving, showing a minimum of wear. Possibly the second type (the composite blocks) may prove to be the ideal form of using rubber for paving purposes.

In another instance experimental rubber paving blocks were laid at the exits of a dock. The paving blocks in this case were 9 in. long, 3 in. wide and 3½ in. deep and consist of hard basic compound with approximately ¾ in. of rubber capping directly vulcanized on the 3-in. width of face. A test piece of roadway of 50 sq.yd. (30x15 ft.) consisting of these blocks on a foundation of 6 in. of cement concrete was laid. The approximate tonnage of loaded vehicles such as motor trucks and wagons (excluding passenger and unloaded vehicles) passing over or brought to rest on the test piece has been on an average 18,000 to 20,000 tons per month. The average total tonnage, however, of loaded and unloaded vehicles traversing this test area would approximate to some 30,000 tons per month.

A close examination has disclosed no signs of wear in the rubber capping surface, and only in two places can any signs of movement be detected; in both these cases a course of the blocks crept forward to a trifling extent, which may probably be attributed to a slight movement in the granite curbs placed at each end of the test portion to enclose the area.

The surface shows no signs of slipping or skidding, which is surprising in view of the fact that the test portion is subjected to fast and slow moving traffic in addition to heavily-laden trucks and wagons pulling up on it and restarting, since, as mentioned before, it is laid outside one of the busiest box offices on the dock premises where the main cargo traffic has to stop while documents are being dealt with.

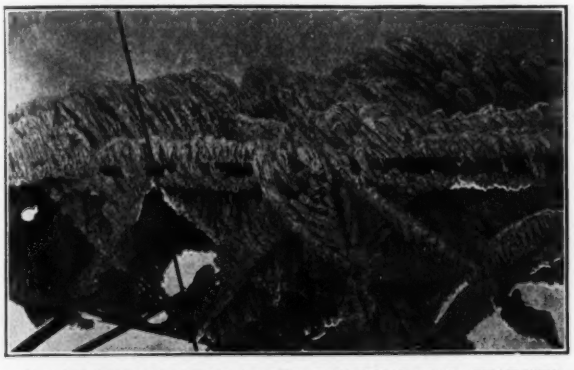
A New Transmission Line Tested by Frozen Fog

Warm Moist Air Rising Into Cold Mountain Regions Encases Transmission Line with Ice—Will Be Insulation Problem

By William D. Shannon
Superintendent of Construction, Stone & Webster, Inc., San Francisco, Calif.

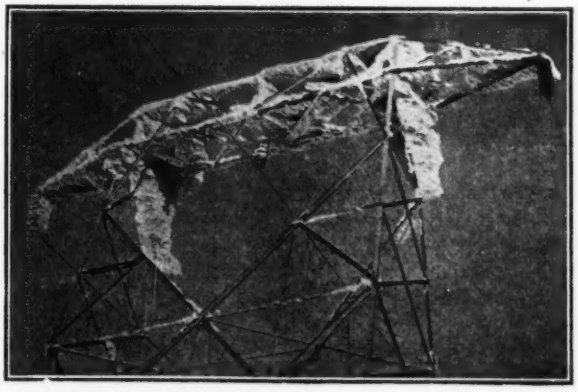
THE 110,000-volt transmission line to carry power from the White River hydro-electric station to the apple district of the Wenatchee Valley in the State of Washington has the unique distinction of passing through five counties, each county showing a special peculiarity of climate. The route that this line follows passes over two ranges of mountains and partially traverses three valleys, thus giving five physical conditions running the whole gamut of weather varieties and ranging from the mild climate of the Puget Sound region, with its high humidity, to the cold dry climate of the Wenatchee Valley.

In one instance there is a conflict between two climatic conditions, which during the first winter of operation produced an interesting phenomenon. This condition



ONE OF THE TOWERS AFTER THAWING HAD STARTED

was found at the boundary line of two counties, which happens to be at the summit of the Cascade Mountains. The elevation at this point is 3,900 ft. above sea level and the mountains are therefore covered with snow during the winter season. At certain times during the winter, the moisture-laden winds from the Puget Sound area blow eastward up the Green River Canyon, keeping at a comparatively low elevation until within two miles of the summit. The rise over the summit is therefore rapid to the point where the winds meet the dry cold air currents from the Kittitas Valley. In its rapid ascent up the slopes of the mountain range, the moisture laden air partially condenses until it becomes a heavy fog. On the last 500 ft. of ascent the fog rapidly congeals and at the summit is of such form that it adheres instantly to anything it touches. At this stage of its transformation, the fog undergoes a small physical change, so that it may be aptly described as "frozen fog" or as one of the engineers described it "fog frango." The accumulation or growth of this "frozen fog" is very rapid and in a few hours' time a steel tower may become coated with one or two feet of the "frango." The accompanying photographs were taken after thawing had started. From all indications, the masses of "frango" on the towers, insulators and conductors must have been enormous, and it is reasonable



ICE FORMATION AT THE TOP OF A TOWER

to suppose that the whole mass of structural steel was as heavily coated as was the top. One photograph shows the top of the tower after all the "frango" on the lower portion had melted away. The top was practically an entire mass of ice.

A windrow of ice and snow on the ground under each wire was mute evidence of the punishment the copper conductor received during the "fog storm." The size of wire in this district was 4/0 H.D. stranded copper. While none of the "frozen fog" was weighed a conservative estimate would be not over 10 lb. per cu.ft.

A recent number of the *National Geographic Magazine* contained a photograph of a similar phenomenon on the summit of Mount Washington in New England.

This transmission line was not in operation at the time this storm occurred. It is being constructed for the Puget Sound Power & Light Co. by the construction and engineering division of Stone & Webster, Inc.

Strain-Gage Used to Check Bridge Reinforcement

In strengthening an old four-span bridge on the Great Northern Ry. by the addition of a center truss, recently, strain-gage measurements were made on the completed structure to verify the assumption made in designing the reinforcement that the three trusses would divide the load in proportion to their respective strengths. H. S. Loeffler, assistant engineer, describing the operation in the *Railway Age* of May 12, states that strain-gages were attached to similar members of the three trusses of a span and the maximum reading of each instrument during the passage of a train was noted. In every test it was found that stresses occurring simultaneously in similar members of the three trusses in any span were practically identical. The bridge crosses the Mississippi River at St. Cloud, Minn., and consists of pin-connected steel truss deck spans, 170 ft. long, built in 1893 on old masonry, and designed for a capacity equivalent to Cooper's E 33. The center truss applied to each span is also pin connected, and is of the same depth as the old trusses, but is placed lower by 6 ft. 3¼ in. to bring its top chord under the floorbeams. It was designed to carry E 30 loading, so that the bridge now is good for E 63. Stiff swaybracing has been inserted. Three other bridges are to be reinforced in similar manner this year: A 160-ft. deck span at Sandstone, Minn., two 215-ft. deck spans at Coram, Mont., and a viaduct at Minot, N. D. A. H. Hogeland is chief engineer and J. A. Bohland is bridge engineer of the Great Northern.

Building a Concrete Flume in Rough Country

Railroad Built Along Line From Source of Materials and Then Taken Up as Flume Is Built in Reverse Direction

By H. K. Fox
Construction Superintendent, San Joaquin Light & Power Corporation, Fresno, Calif.

A CONDUIT and flume line, 2½ miles long, was recently completed by the San Joaquin Light & Power Corp. on the north fork of the San Joaquin River in California, by means of which the water supply serving a chain of six power houses will be materially increased. The inacessibility of the upper end of the conduit line and the fact that a grade for a flume was cut along approximately the same location in 1910 made it advisable first to build a construction railroad along this old line, beginning at the lower end which was reached by road, and then to build the new conduit from the upper end down. With this plan a constantly advancing source of water supply was made available by admitting water from the upper end to completed sections of the conduit. The entire job was finished in eight months with one daily 9-hour shift.

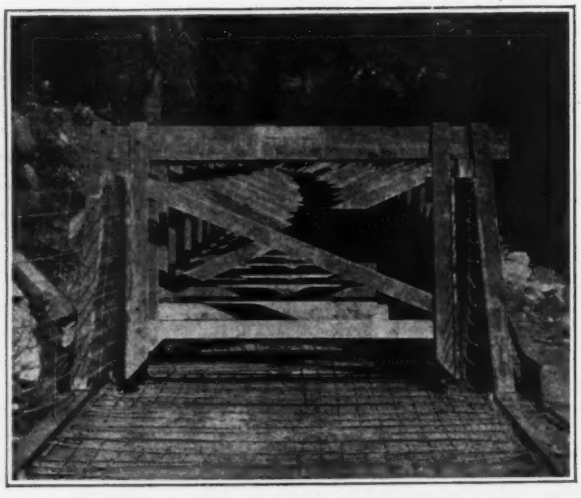


FIG. 1—FORMS AND REINFORCING IN PLACE

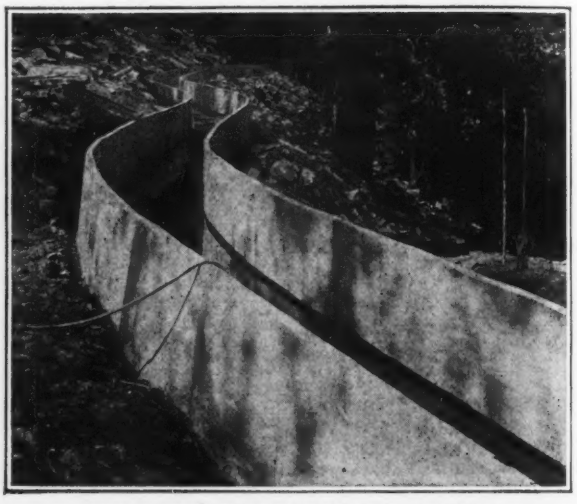


FIG. 2—COMPLETED CONCRETE FLUME

The original conduit built in 1910 to provide sluicing water for the Crane Valley Dam was a combination unlined ditch and wooden box flume with a capacity of 30 sec.-ft. The flume and trestles were largely destroyed by forest fire. The new conduit line consists of concrete lined ditch, concrete box flume, and riveted steel flume on redwood trestles, all with a uniform capacity of 100 sec.-ft. Very careful figuring was required to make the new construction fit the old grade and at the same time conform to uniform cross-sections as far as possible. It was not advisable to change the section more often than absolutely necessary, due to the additional cost and delays which such changes made in forms and reinforcing.

A construction headquarters was first established at the lower end of the line and a small warehouse and material yard were built there. An 18-in. gage railroad with 12-lb. rails was then constructed. Most of the ties were salvaged from what was left of the old flume and the track was laid alongside the old ditch, on the upper side where possible. Where the line crossed ravines, trestles, to be used later by the steel flume, were built first and the railroad was carried across on them. The trestles were built as the railroad advanced so that except for a small amount of cement used in the trestle footing no material had to be carried in on the backs of workmen.

As soon as the track reached the intake, construction of the small concrete arch dam was immediately started just above the old rock crib diversion. This new diversion dam is about 30 ft. long, 2 ft. thick throughout and 10 ft. in height, with reinforcing in both faces. A very simple form of inlet gate made of redwood was used. Thus a source of water supply and inlet control at the flume head was provided before construction of the conduit itself was started.

The material handling plant was small and simple. A quarry was opened on the right-of-way and a 9x18-in. jaw crusher set up over a 40-cu.yd. storage bin. The crusher jaws were set to produce rock with a maximum size of ¾ in. and because of this close setting produced a greater portion of the sand than would otherwise have been obtained. The product was not screened, crusher run being used by adding some sand. A spur from the track allowed dump cars to run under the chutes of the bin. Three 1-cu.yd. cars were handled in a train by homemade locomotives consisting of a Ford engine mounted on a steel frame with a special transmission to chain sprockets on all four wheels.

These locomotives proved very successful. There were several short stretches in the track which had grades as high as 14 per cent and on these the locomotives would haul 120 sacks of cement. The usual requirements of the locomotives under these operating conditions were 7 gal. of gasoline and 1 quart of oil for nine hours service.

The mixer was a gasoline-driven, one-sack batch machine specially mounted on flanged wheels. Six successive setups were used at advantageous points on the line. At each of these points the mixer was placed on a spur where it could discharge into cars on the main track. For the ditch lining the concrete was discharged directly from the cars into the ditch and for filling the forms for the box flume into concrete buggies which traveled on a plank runway laid on top of the forms.

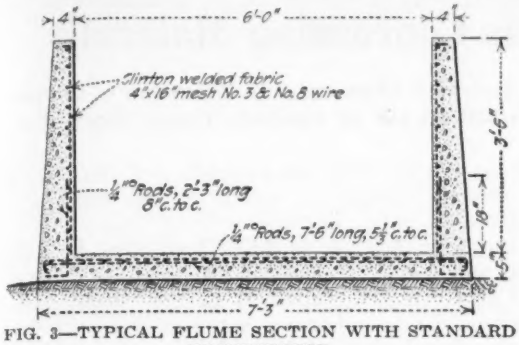


FIG. 3—TYPICAL FLUME SECTION WITH STANDARD REINFORCING

This section has the following hydraulic values: grade, 1 in 675½; velocity, 5.54 ft. per second; flow, 100 sec.-ft.; value of N in Kutter's formula, 0.014.

Thus the advantage of having the track above the conduit is apparent. The only available water supply was that retained in the flume itself by sack dams built across completed sections of the flume as near the work as possible. A gasoline-driven pump delivering into a 2-in. pipe line to the mixer and ditch-shaping crew was installed with its intake just behind the sack dam. One day was required to move the dam and pumping equipment forward as work progressed.

The old ditch section was enlarged to carry 100 sec.-ft. and before placing the concrete the earth was well soaked to avoid settling away from the lining. The maximum progress for the concreting crew of 10 men per 9-hour day was 360 lin.ft. A fairly dry concrete was used, the floor being poured first and the sides on the day following. No difficulty was experienced in placing the concrete on the slope, the method being simply to throw it on with shovels to the depth of the squeeds, and smooth it up with wood floats following with steel floats for the finish; no skilled labor was used. The best progress on the sides alone was 385 ft. per day.

The concrete box flume was designed without expansion joints, sufficient steel being provided so that nothing but hair cracks is expected as the result of temperature changes. To date practically no visible cracks have developed. The reinforcing was varied to give the flume box additional strength where the floor was not fully supported or where there was considerable external earth pressure.

Type 1 reinforcing, illustrated in the accompanying cross-section, was standard, and to this was added more steel as specified in types 2 and 3 (not illustrated) which were designed to meet the two special cases mentioned where additional strength was required.

FIG. 4—FORD LOCOMOTIVE WITH TRAINLOAD OF 120 SACKS OF CEMENT

The forms were the key to the rapid progress made in constructing the box section. They were designed with practical considerations paramount and no changes were found necessary as the work proceeded. The panels, made of 1-in. ship-lap, were all 3 ft. long and 3½ ft. high, no specials being used on curves. To make curves with forms of standard length, wall forms for the longer or outer side of the curves were supplemented by strips or "Dutchmen" of varying width placed between the ends of the panels.

The process of setting up forms and pouring concrete was programed as follows: (1) the 2x6-in. sills were carefully set to line and grade, (2) floor reinforcing placed, (3) outside panels with cross-ties on top set in place, (4) side reinforcing, (5) inside panels, and, finally, (6) cross bracing.

The wall forms were held in place at the top by the 2x8-in. cross-ties bolted to the panel studs. At the bottom the outside panels were prevented from spreading by No. 10 wires laid across the sills in pairs and twisted up, after the panels were placed, around the bottoms of the panel studs. These wires extended the full width of the flume box from outside to outside. The panels were fastened to one another, at the outset, by hook bolts. Nailing blocks were soon substituted as being much faster and better suited to the use of "Dutchmen" on the curves.

FIG. 5—PLACING CONCRETE IN LINED DITCH

The maximum progress for a crew of six men in setting up the forms complete was 200 ft. per day. The maximum progress in pouring was about 238 ft. per day. The floor was ordinarily kept poured about 20 ft. ahead of the sides.

Concrete was delivered from the mixer in side-dump cars, a maximum distance of 2,000 ft., but because of the danger of taking initial set en route it was not found advisable except in unusual cases to deliver distances greater than 1,000 ft. from the mixer.

The work was done by the San Joaquin Light & Power Corp. under the direction of R. C. Starr with the writer as superintendent of construction and A. M. Smith as resident engineer.

New Specifications and Facts Concerning Materials

Twenty-sixth Meeting of American Society for Testing Materials Shows Steady Extension of Committee Work—Society to Cultivate Research in Materials—Behavior of Concrete Under Discussion

CONTINUED broadening of the scope of its specification work was apparent at the meeting of the American Society for Testing Materials at Atlantic City last week. The organization entered its second twenty-five-year period of existence with the novel condition of having relatively little specification work to report in the field of the major materials—steel, cement and wood—but a great deal in miscellaneous materials and items, from broken slag and rubber matting to thermometers. There was rather more than the usual number of technical papers, in line with the deliberate effort of the past few years to develop this side of the society's work more fully. New results of the study of materials and various interesting new instruments were described. Several special subjects were discussed at considerable length, one of them being the group of phenomena and terms described by such words as consistency, plasticity, workability, and the like, and another being the condition of concrete structures, with special reference to the defects which they have developed in service. This latter discussion, despite the unfavorable condition of being placed in the closing session—the thirteenth—of an excessively long and fatiguing meeting occupying an entire week, was in certain respects its most important and most sensational feature.

With nearly 900 members in attendance, the meeting far surpassed previous ones in point of size, and represents an increase well beyond the increase in total membership.

To Develop Research—Carrying out a suggestion made in the presidential address of J. A. Capp several years ago, the society has now decided to enter upon a systematic effort to stimulate and cultivate research in its work and its meetings.

Special emphasis was laid on the importance of research in the address of the retiring president, Dr. George K. Burgess, director of the Bureau of Standards, which had the general subject "The Trend of Standardization." The main portion of the address was a strong exposition of the value of standard specifications and a denial of the charge that has sometimes been made that standardization will interfere with the freedom of development of the arts.

A matter also dealt with in the address, and one which is assuming renewed and serious importance in the society's work, is the difficulty of obtaining proper balance between producer and consumer in the formulation of specifications. The charge often heard in former years that the specifications of the society are essentially manufacturers' specifications is again coming to the front, and has received serious consideration in the councils of the society. President Burgess referred to "the importance of maintaining adequate attendance of representatives of consumers' interests at committee meetings to secure at all times a real balance of producer and consumer in the formulation of standards and specifications."

Talbot Made Honorary Member—Past president Arthur N. Talbot was elected to honorary membership in the society, in recognition of his long, brilliant career in the study of materials and the testing of structures, carried on mainly at the University of Illinois.

Guilliaem Aertsen, of the Midvale Steel & Ordnance Co., was elected president of the society to succeed Dr. Burgess. W. H. Fulweiler, of the United Gas Improvement Co., is the new vice-president, and the following four become members of the executive committee: J. H. Chubb, of the Universal Portland Cement Co., T. G. Delbridge, of the Atlantic Refining Co., H. L. Scott, of Henry L. Scott & Co., and P. H. Walker, of the U. S. Bureau of Standards.

In the general field of the society's committee work the meeting showed that important work is being done in two new fields entered within the last year or two, namely, the unification of nomenclature in the field covered by the society, and the harmonizing and standardizing of test methods. On the latter subject, the committee on methods of testing presented an outline specification for tension tests of metals. However, it also proposed to change the current definitions of stress and strain by defining stress as the intensity of internal force in a piece in pounds per square inch, and strain as the deformation per inch of length. There was much opposition to this radical proposal, but by rather routine vote it was approved by the meeting for tentative publication. The committee has laid out an extensive program of work, with the ultimate purpose of placing all test procedure on a standard basis, and its work so far is only a beginning.

Progress in Specifications—While most of the specification committees of the society work independently rather than in conjunction with other societies, the reports of the past year's work presented at the meeting indicate that there is steady improvement in the general tie-up the committees with other organizations. Contact secured in this way led to the revision of several specifications during the past year, including those for trolley wire, in which field there is a close tie-up with the work of the American Electric Railway Engineering Association. Direct co-operative work was not noticeably extended during the past year.

The broad range of the specification work and its highly detailed and specialized character in most instances make it impracticable to review this work here. The new specifications presented at the meeting, all of which were approved by the meeting for publication as tentative, are listed below.

Steel
- Boiler and fire-box steel for stationary service
- Steel plates of flange quality for forge welding

Copper Wire
- Hard drawn copper trolley wire
- Soft rectangular copper wire
- Hot-rolled copper rods for wire drawing

Corrosion of Iron and Steel
- Method of determining weight of coating on zinc-coated articles
- Method of determining weight of coating on tin, terne and lead coated sheets

Wire Cloth
- Non-ferrous screen wire cloth

Metallography
- Definitions of terms relating to metallography
- Recommended practice for photography as applied to metallography
- Methods of metallographic testing of non-ferrous metals and alloys

Timber
- Test for coke residue of creosote oil

Methods of Testing
- Methods of tension testing of metallic materials
- Definitions of terms relating to methods of testing
- Methods for verification of testing machines

Road and Paving Materials
- Method of test for the determination of proportion of bitumen insoluble in carbon tetrachloride
- Asphalt cement, 25 to 30 penetration, for use in sheet asphalt and asphaltic concrete
- Asphalt cement, 30 to 40 penetration, for use in sheet asphalt and asphaltic concrete
- Natural or artificial sand-clay mixtures for road surfacing
- Broken slag for bituminous macadam wearing course
- Broken slag for bituminous concrete (coarse-graded aggregate type)
- Broken slag for bituminous concrete (fine-graded aggregate type)
- Sand for sheet asphalt and bituminous concrete pavements

Lime
- Method for measurement of consistency of lime pastes

Gypsum
- Gypsum partition tile or block

Coal and Coke
- Method of test for volume of cell space of lump coke
- Gas and coking coal

Paint and Varnish
- Definitions for toughness and elasticity
- Tests for specific gravity or pigments
- Methods for testing shellac
- Methods of testing oleoresinous varnishes

Waterproofing Materials
- Asphalt mastic for use in waterproofing
- Bituminous grout for use in waterproofing above ground level
- Bituminous grout for use in waterproofing below ground level
- Felted fabric saturated with bituminous substances for use in waterproofing
- Woven cotton fabric saturated with bituminous substances for use in waterproofing
- Burlap saturated with bituminous substances for use in waterproofing

Petroleum Products
- Method of test for water in petroleum products and other bituminous materials
- Method of test for color of lubricating oil by means of Union colorimeter
- Method of test for color of refined petroleum oil by means of Saybolt chromometer
- Method of test for steam emulsion of lubricating oils
- Method of testing gas oils

Electrical Insulating Material
- Method of test of electrical insulating materials for voltage effects at radio frequencies
- Method of testing cable splicing and pothead compounds

Rubber Products
- Wrapped cold water hose
- Rubber matting for use around electrical apparatus or circuits not exceeding 3,000 volts to ground

Textile Materials
- Imperfections and tolerances for cord tire fabrics
- Tolerances and test methods for cotton yarns and cords
- Tolerances for hose ducks and belt ducks

Thermometers
- Thermometers (four classes)

Following long established custom in the society, the committees reported these specifications as well as numerous detailed revisions of existing specifications without indicating reasons or essential elements. In consequence the proceedings in the meeting, so far as they related to the committee work, were formal and devoid of any special interest. Quite recently, however, the executive committee decided to change this practice by calling for statement of reasons in connection with the revision and formulation of standards in future.

Phosphorus and Sulphur Investigation—A second report of the joint committee on investigation of phosphorous and sulphur in steel was presented, in preliminary form. While the definite data are not yet ready for publication it was stated that in plate steel, with sulphur ranging up to 0.15 per cent, the results are substantially the same as previously reported for rivet steel, showing no influence of sulphur variation upon the several strength properties of the material, except that the Charpy impact values are erratic.

Corrosion Test Results—Further report was made on the elaborate exposure tests of bare iron and steel sheets conducted by the committee on corrosion of iron and steel. Atmospheric exposure tests at Pittsburgh, at Fort Sheridan (Ill.), and Annapolis confirm the previously indicated conclusion that steel containing copper is much more resistant to corrosion than steel free from copper. Three other sets of tests, with the samples immersed in water, have not yet led to definite conclusions, but up to the present show that copper-containing steel has no advantage over copper-free steel in water immersion. As the tests have developed up to the present, the acid mine water at Calumet, Pa., has six or seven times as rapid a corrosive effect as city water in Washington, and the latter has several times as strong an effect as brackish water at Annapolis.

New Instruments—Two remarkable extensometers were described, both having been developed during the past year at the Bureau of Standards. O. S. Peters and R. S. Johnston, under the title "New Developments in Electric Telemeters" described the carbon resistance extensometer which has already found useful application in the test of wide web plates made for the Delaware River Bridge Commission. L. B. Tuckerman, in a paper on "Optical Strain Gages and Extensometers," described a mirror extensometer with ingenious triple-reflection optical lever and an autocollimetor reading telescope, which with the triple mirror eliminates disturbance and errors due to shift of the telescope, and has a very high sensitivity, reading easily to 0.00001 in. in displacement. Another ingenious instrument was described by E. B. Smith, of the U. S. Bureau of Public Roads, under the title "An Accelerometer for Measuring Impact." In this device a small hammer moving against a spring and automatically held in the position of its extreme throw measures the force of negative acceleration. It is available for truck-wheel impact and pile-driver work and the like.

A wear machine developed in the Goodrich laboratory to measure the abrasive resistance of rubber compounds was described by W. W. Evans. G. B. Haven presented "A Constant Load Rate Testing Machine for Textiles." In this instrument the load is applied by a weight resting on an inclined plane, and changing the inclination of the plane changes the load in uniform increments. A device by which the color of oils may be compared more effectively than heretofore was described by D. C. Cox, under the title "A Method for the Estimation of Color in Oils." The instrument com-

pares the amounts of blue light absorbed by two oils, these amounts taken to be a measure of the yellow or red color of the oil.

Chemical Limits for Cast Iron—In a topical discussion on the subject "Is It Desirable to Include Chemical Requirements in Specifications for Cast Iron?", Robert Job upheld the view that good results cannot be obtained, in many classes of cast-iron service, without careful specification of the limit of various elements, such as sulphur, combined carbon, and the like, while Richard Moldenke urged that the foundryman be left free to meet the required physical properties by any chemistry that he finds suitable. However, Mr. Moldenke admitted the need for fixing chemical limits in certain cases, and the general result of the discussion was to support strongly the modern tendency toward fixing chemical requirements for cast iron almost as definitely and fully as for steel. H. J. Force, in particular, made a strong presentation of the case for chemical specifications in car wheels and locomotive cylinders.

Magnetic Analysis—An elaborate study of magnetic analysis in application to twist drills was reported by the committee on magnetic analysis. Some fifty or sixty drills especially made for the purpose were tried as to their cutting properties and their magnetic properties, and in general no correlation was found. In connection with the same work, however, A. V. de Forest developed an instrument in which two independent magnetic measurements are taken on the sample, the claim being made that under proper manipulation the magnetic measurements indicate respectively the quenching temperature and the drawing temperature of the specimen, thereby in turn indicating the cutting power. Some success was attained in applying this instrument to the drills, suggesting the need for further study.

Paint Studies—H. A. Nelson and G. W. Rundle gave results of elongation measurements on paint films, and the effect of moisture on the elongation. No direct conclusions followed.

Two papers on the relation between white paint pigments and ultra-violet light demonstrated convincingly that certain pigments reflect more ultra-violet light than do other pigments, but opposite conclusions were drawn, one showing the advantage of zinc oxide, the other the advantage of white lead. Discussion of the two papers merely continued the general antagonism of the zinc and lead interests that has been displayed in previous paint sessions of the society.

Preservative Value of High-Test Creosote—A final report on a fungus-bed test of wood preservatives was presented by Cloyd M. Chapman, covering some 30 different preservatives and several kinds of wood. The results indicate that high-boiling creosotes are the best preservatives, but that no preservative and no method of treatment tried will furnish complete protection from active decay attack. An abstract is given on p. 27 of this issue.

New Facts on Fatigue of Metals—Elaborate further data on the fatigue of steel were presented by D. J. McAdam, Jr., of the Naval Engineering Experiment Station, while R. R. Moore of the Army Air Service reported on extensive fatigue tests of manganese bronze, duralumin and electron metal. These papers made important additions to the knowledge developed by the fatigue research carried out at the University of Illinois under the auspices of the National Research Council. An abstract of the results of one of the papers is given on p. 26 of this issue.

Of the other papers presented, the following may be noted: "Methods of Casting Test Specimens of Gun Metal," by E. H. Dix, Jr.; "The Influence of the Ratio of Length to Diameter in the Compression Testing of Babbitt Metal," by John R. Freeman, Jr., and Paul F. Brandt; "The Properties of Metallurgical Coke," by G. S. Perrott and A. C. Fieldner; "The Significance of Tool Temperatures as a Function of the Cutting Resistance of Metal," by H. A. Schwartz and W. W. Flagle; "Gases in Metals," by Louis Jordan; "The Testing of Glue," a discussion led by Jerome Alexander; "Some Relations Between the Characteristics of Straight Distilled Tar Residues," by J. W. Kennedy; "Use of an Air Bath in Determination of Solid Residue of Road Oils at 100 Penetration," by H. F. Clemmer and H. C. Helmle; an elaborate scientific dissertation under the title of "Color," by G. W. Thompson; "A New Combined Viscometer and Plastometer," by E. C. Bingham and H. A. Perry, Jr.; and several papers on insulating varnishes and on slate.

What is Consistency?—The best part of one session was devoted to the discussion of the principles underlying the measurement of consistency, plasticity and related properties, particularly as such discussion might lead to a definition of consistency. It was introduced by F. G. Breyer and Henry Green, of the New Jersey Zinc Co., who define consistency as "that property of a plastic material which it possesses by virtue of its yield value and mobility, and manifests itself as resistance to flow." W. E. Emley, of the lime committee said since lime which can maintain its consistency long enough to permit completion of the work is said to be plastic, it may be said that plasticity is a property inherent in the lime itself and has nothing to do with consistency. Duff A. Abrams, of the concrete committee, submitted the definition "The relative plasticity or workability of freshly mixed material" and explained the work that has been done of late to determine that quality in concrete. It is evident that this committee considers the term in its practical application as describing a readily observable, though not necessarily readily measurable condition, and not as a physical property. Prof. E. C. Bingham (Lafayette College) after defining in the terms of physics the qualities viscosity, plasticity, mobility, etc., said that the present looseness characterizing the word "consistency" would be avoided if its use were restricted to the definite meaning of the reciprocal of mobility, for which there now exists no term. Dean A. N. Johnson said that consistency should be used as indicating a condition and not a property, and that a definition should be made on the basis of determining the phenomenon which brings about the condition.

The discussion may have served to bring out more clearly a divergence in view between the physicist and the man interested in producing and using materials, but it did little to clarify the understanding of the word in either of the two groups.

Concrete Brick Postponed—Committee C-4, on Brick, put on record the six standard sizes for paving brick adopted by the conference organized by the Department of Commerce, and voted to submit to the letter ballot of the committee the suggested specifica-

tion for concrete brick which the committee rejected last year. This postpones for one year consideration by the society of the concrete brick specification which the advocates of that type of brick claim was justified by the recent tests by Columbia University (see *Engineering News-Record*, May 31, 1923, p. 959).

Cement and Concrete—Little developed in the field of cement and concrete. Committee C-1, on Cement, had no recommendations but reported that it was continuing the study of the compression test for cement and also studying the general nature of cements with a view to improving specifications. Committee C-9, on Concrete and Concrete Aggregates, submitted a revised tentative specification for aggregates, which includes a new section on grading of fine aggregate and coarse aggregate both, changed from circular to square openings in grading the coarse and admitted air-cooled blast furnace slag as a suitable aggregate. In this latter connection the report says:

> In regard to the changes which have been made in the paragraphs dealing with coarse aggregates, the recognition of air-cooled blast-furnace slag is the most important. A large amount of test data has shown this material to be acceptable as concrete aggregate, and there is also a large amount of data from the field in testimony of the durability and permanency of slag concrete structures. The only special restriction which has been put upon this material is a limitation upon weight per cubic foot, the specified weights being high enough, it is believed, to exclude undesirable material. No restriction has been placed upon the sulphur content of slag, for the reason that inspections made by members of the committee of reinforced slag concrete structures in the course of demolition showed no corrosion of reinforcement that could be attributed to slag, nor is there any published evidence that such corrosion has been observed, so far as the committee is aware.

In a report for the Joint Committee on Concrete and Reinforced Concrete, Richard L. Humphrey, chairman, told of the status of that committee's final report. He said that the committee did not intend to cover all phases of the uses of cement but merely intended to bring the old report to date. He thought that there had been fair criticism of the committee's provisions on quality as not being entirely practicable and said that the committee was considering that part of the report with the greatest care. It is intended now to review all the criticisms of the report and to prepare a final report which should be ready next year. As a final word he said the committee considered itself in a judicial position, not to formulate opinion but to crystallize practice.

Several excellent papers on concrete were presented at one of the sessions. They include a study of calcium chloride as a curing agent and accelerator, by H. F. Clemmer and Fred Burggraf, of the Illinois Highway Division; the fatigue of mortar, by R. B. Crepps, of Purdue University; a new test for workability by J. C. Pearson and F. A. Hitchcock, of the Bureau of Standards; and a paper on blast furnace slag aggregate by Raymond Harsch, of the Bureau of Public Roads. Abstracts will appear in an early issue.

Behavior of Concrete—Great interest was aroused in a symposium on the service study of concrete. Although this was set for the last night of the meeting some 200 members were present. The subject of the symposium was "What Properties of and Methods of Making Concrete Require Further Investigation?—A Discussion of the Requirements of Concrete to Meet the Many Varieties of Service Conditions. What Can Be Learned From Behavior of Actual Structures?" The scheme of the discussion was first to consider the constituents of concrete and its methods of making, in the light of service requirements, with a view to developing future possibilities in cement, aggregates and proportioning. This was followed by a study of service conditions in roads, sea water, alkali water and under the normal attacks of weather.

The subdivisions, briefly considered, were as follows: P. H. Bates, (Bureau of Standards) discussed the behavior of concrete under three conditions of exposure —ordinary air moisture, non-sulphate water and sulphate water, and considered the cement requirements for each. His conclusions are that for each there are possibilities of improvement in the cement itself, though the needed improvements may differ in detail for different uses. He recommended a new slogan "Concrete for Study." Duff A. Abrams (Structural Materials Testing Laboratory) discussed aggregates. He said that the strength and resistance of concrete depended more on proportioning and methods than on aggregate, which if well graded, clean and structurally sound could be made to produce good concrete regardless of other qualities. He emphasized, therefore, further study of methods of manufacture. R. B. Young (Hydro-Electric Power Commission of Ontario), considering methods of proportioning and mixing, noted the complications of applying the newer methods in this field, emphasized the necessity for more careful measuring and for more study of the mechanism of mixing and of the influence of plant design. Arthur P. Davis (Washington, D. C.) reported the behavior of mass concrete under the varying service requirements of the Reclamation Service. P. J. Freeman (Pittsburgh) cited several cases of bad disintegration and concluded that density is the great desideratum, not strength. A. T. Goldbeck (Office of Public Roads) cited the numerous details of design and construction of concrete roads that have resulted in undesirable conditions, with a view to pointing out proper methods. S. C. Hollister (Philadelphia) summarized the knowledge on the behavior of concrete in sea water and G. M. Williams (University of Saskatchewan) of concrete when exposed to alkaline conditions.

This comprised the formal reports. Some twenty informal discussions followed. They, together with the main reports, will be abstracted in a later issue. As the chairman, Prof. A. N. Talbot, said at the close of the session, the symposium was worth while as a resumé of the present state of knowledge of concrete and as an indication of where to look for improvement. It is perhaps pertinent to remark that the high points of the discussion were the contention of Mr. Bates that present cement standards do not satisfactorily cover all kinds of service and that different cements for different purposes may prove advantageous; the opposition, based mostly on economic grounds, by the cement manufacturers to multiple standards; the statement of the manufacturers that they are now engaged in a thorough chemical and physical study of the nature of cement which conceivably may lead to an improvement in the product; and finally the repeated conclusions of discussors that improvement of concrete lies mostly in the bettering of workmanship, though there are many instances of poor concrete not altogether explained on this ground.

Abstracts of Test Methods and Results

Principal Points in a Series of Papers Read Before the Atlantic City Convention of the American Society for Testing Materials, June 25-29

Accelerometer for Measuring Impact

Abstract of a Paper by Earl B. Smith

THE force of impact in most cases cannot be measured directly as can be done by weighing a static force. It is a product of mass and acceleration, and the most convenient and direct method of determining this impact value is by means of an accelerometer which may be attached directly to the moving body or hammer and which will indicate the acceleration value.

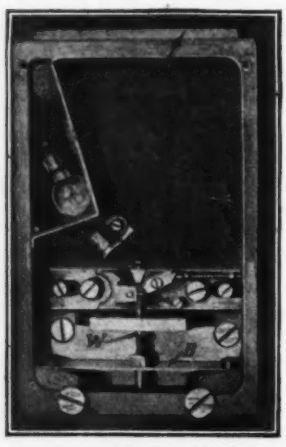


FIG. 1—ACCELEROMETER WITH OPTICAL LEVER

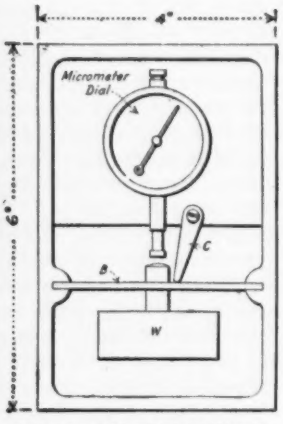


FIG. 2—ACCELEROMETER ARRANGEMENT

The essentials of a small accelerometer are shown diagrammatically in Fig. 2. Within a rigid frame is mounted a steel beam, *B*, supported only at the two ends. At the center of the beam is attached a mass, *W*. A toggle, *C*, is provided which will hold the beam at any maximum deflection position until the amount of deflection may be measured with the micrometer dial. In use, the accelerometer is rigidly attached to the moving body or hammer, with the plane of the beam *B* at right angles to the direction of motion or to the line of action of the force to be determined. When the velocity is constant there will be only the static deflection of the beam, but when the velocity is changed and the acceleration is negative the beam will be further deflected because of the inertia of the mass *W*; that is, under the influence of a deceleration (negative acceleration) the mass *W* will exert a force which will deflect the beam. By properly proportioning the beam and its attached mass, the range of the instrument may be made suitable for any desired condition. The deflection of the beam must be restricted to very small limits; it is kept within about 0.015 in. and the exact amount is read from a micrometer dial or by means of an optical lever system.

An improved design of instrument is shown in Fig. 1. In this case the beam *B* has fixed end supports and its maximum deflection is 0.003 in., which is measured by the movement of a beam of light giving a magnification of about 800. The stem *W*, which is also the weight attached to the beam, operates a small oscillating mirror at *M*. The light from a small electric lamp is focused by the lens *L* onto the small mirror and reflected to the scale *S*. At *R* is a stop or brake which holds the small mirror in its deflected position after the deflection of the beam until the reading may be made from the scale. A small push rod allows the brake to be released and the mirror returned to the zero position. The weight of the stem and parts *W* supported on the beam, including one-half the weight of the beam, is 0.0249 lb.; the static weight necessary to deflect the beam and move the light ray on the scale 1 in. is 0.650 lb.

A calibration curve for this instrument compared with the results from a space-time curve indicates a reliable degree of accuracy. The range of this accelerometer is from about 2 to 25 times the acceleration of gravity. Continuous records may be obtained by a photographic recording attachment.

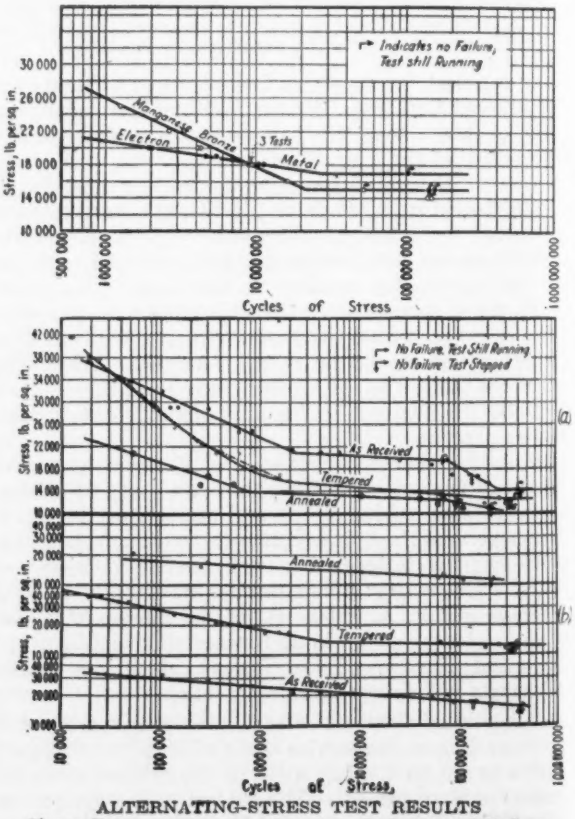
These accelerometers were originally designed for use at the Bureau of Public Roads on autotruck wheels and axles in connection with special investigations of the impact of trucks on roads.

* * *

Endurance of Duralumin, Electron and Manganese Bronze

Abstract of a Report by R. R. Moore on Investigations by the Engineering Division of the Air Service at McCook Field

ENDURANCE tests on three of the most important light alloys were carried out by means of a rotating-beam machine, which subjected the test bar to alternating stress. The general character of the results is shown by the curves reproduced herewith. In contradistinction to the results found for steel and other ferrous materials by H. F. Moore at the University of Illinois, in whose tests a definite



ALTERNATING-STRESS TEST RESULTS

Upper diagram, manganese bronze and electron, plotted on semi-logarithmic paper; middle diagram, duralumin plotted on semi-logarithmic paper; lower diagram, duralumin on logarithmic paper, which fails to reveal important features of the curves.

endurance limit was found, that is, a stress below which the material would stand an indefinitely large number of stress reversals, the McCook Field tests indicated that beyond an early endurance limit there is a further dropping off of the curve, at least in the case of duralumin tested "as received." It is concluded that the endurance limit of duralumin cannot be obtained by tests carried only to 10,000,000 cycles.

The endurance limit for there metals was not found to bear any constant relation to other physical test properties. The endurance limits from the tests are reported to be the following:

Manganese bronze	15,000 lb. per sq.in.
Electron metal	17,000 lb. per sq.in.
Duralumin, as received	14,000 lb. per sq.in.
Tempered at 920 deg. F.	12,000 lb. per sq.in.
Annealed at 700 deg. F.	10,860 lb. per sq.in.

Vibration was not found to affect the results materially. All the tests were run at a speed of 1,500 r.p.m., which is above the first critical speed for the size and shape of specimens tested, but yet resulted in considerable vibration in some of the specimens.

* * *

Effect of Wood Preservative Treatment Tested in Fungus Bed

Abstract of a Paper by Cloyd M. Chapman

TEST specimens of wood treated by different preservative methods were exposed in an outdoor fungus bed ten years ago. An initial report on this test rendered in 1915 is now supplemented by a final report. The fungus bed (outdoor) was prepared by mixing decayed wood and dry pulverized sheep manure with well sifted soil. Twelve-inch stakes, 1½ x ½ in., pointed at one end, were driven about 9 in. deep into this bed. Oak, cypress, spruce and yellow pine were used. The preservatives were applied in three ways: cold dip for 15 sec., hot dip for 1 min., and hot immersion for 1 hr. followed by cooling in the preservative. Thirty preservatives were used, including various tar products, mineral, vegetable and animal oils, and solutions of inorganic salts.

The results indicate, according to Mr. Chapman, that coal-tar and water-gas-tar derivatives are superior to the other classes of materials used. These creosotes show a higher average degree of protection than any other material tested. Among the creosotes themselves there are some considerable variations; in general, the higher-boiling fractions seem to be the more effective. None of the preservatives gave permanent protection against decay under the conditions of this test.

There seems to be but little difference between the cold-dip and the hot-dip treatment. Hot immersion, or boiling, is very much better (though at much higher cost), but even the approximate saturation which may at times be attained by the boiling treatment does not render the wood immune from decay in the course of time.

* * *

Properties of Slate

From a Paper by Oliver Bowles, Mineral Technologist, U. S. Bureau of Mines

A SERIES of roofing slate recently tested showed a modulus of rupture of 8,200 lb. per square inch, which is about five or six times the strength of average sandstone or limestone and three or four times that of average marble. Ribbons in the slate do not necessarily affect the strength, as was shown by fractures crossing the ribbons in a special set of tests of slabs of ribboned slate at the Bureau of Standards. The porosity of slate averages 0.38 per cent, which means that average slate is well adapted for sanitary uses. The coefficient of expansion of the material is 0.000005 (Watertown arsenal tests).

Production and market requirements of slate do not permit of reducing the number of sizes of roofing slate. In Cincinnati, Ohio, and Galveston, Tex., the principal demand is for 10 x 12-in. slate; in Chicago, 10 x 16-in.; in Columbus, Ohio, 12 x 24-in. A variety of sizes permits the demands of various localities to be suited and also permits of utilizing the raw material to best advantages with a minimum of waste.

In laying slate roofs a 3-in. head lap should be the universal standard. The nails should be as permanent as the slate.

Abrasion resistance of slate has not been sufficiently studied, but experience shows that there are very great differences in the resistance of various slates to wear, when used as stair treads and the like.

Standardization is needed in many directions in connection with slate, and much experimental work should be conducted as a basis for correct and logical specifications. The need of specific requirements is outstanding in the matter of thickness, size, and color stability of roofing slate, quality of blackboard slate, strength and abrasion of structural slate, and insulating value of electrical slate.

* * *

A Successful Distant-Reading Extensometer

Abstract of a Paper by O. S. Peters and R. S. Johnston

A REMOTE-READING extensometer has been developed at the Bureau of Standards which utilizes the pressure-resistance or displacement-resistance characteristic of a stack of carbon plates. Heretofore attempts to utilize this

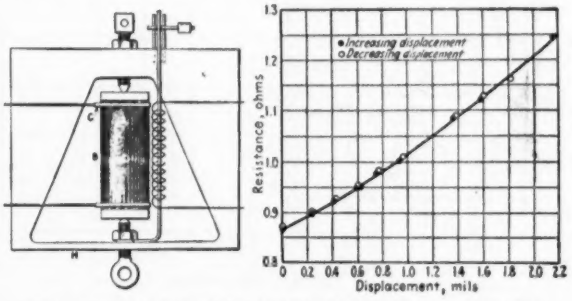


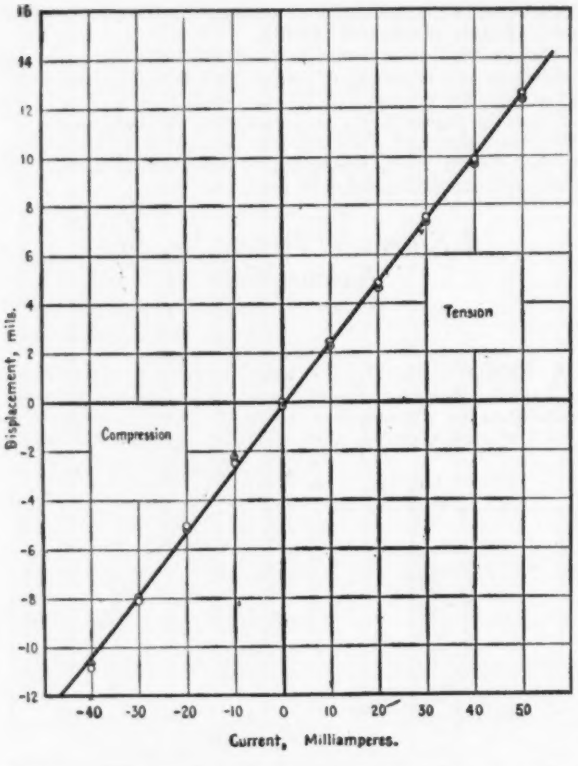
FIG. 1—SINGLE STACK OF CARBON PLATES AND ITS DISPLACEMENT-RESISTANCE CURVE

characteristic of carbon for engineering measurements have been unsuccessful because of erratic behavior of the resistance of the carbon stack, hysteresis effects, and the non-linear relation between displacement and resistance. The resistance of the stack has now been stabilized and changes of resistance with changes of pressure made reproducible, by mounting the stack in a frame in such a way that it is always under considerable pressure, and confining the range of change of pressure within narrow limits; the pressure on the stack is applied axially, and great care is exercised in assembling in order to make transverse forces on the carbon contacts as small as practicable. Hysteresis effects, which cause the resistance of the stack corresponding to a given pressure to differ for increasing and decreasing readings, have been made negligible by using a mounting frame without mechanical joints, as experiment showed that the cause of the hysteresis lay in these joints rather than in the stack itself. The non-linear characteristic has been made straight by mounting two stacks of plates in each instrument in such a way that the resistance of one is decreased and the other increased by the force or displacement under measurement; the cumulative change of resistance of the two stacks has been found to be proportional to the change of displacement or pressure, with the ultimate result that an instrument with substantially a linear calibration curve is obtained.

A single stack of carbon plates mounted in a steel frame as shown in Fig. 1 is placed under pressure from the spring-like part *H* of the frame, the pressure being adjusted by set screws at either end. The carbon plates *B* are ring-shaped pieces, about fifty in number, held between mica end plates and connected to a circuit by brass contact disks *C*. The mirror and magnetized rod at the right are an auxiliary

calibrating device. This stack gives the displacement-resistance curve shown in Fig. 1; the resistance changes about 46 per cent for a change in length of the stack of 0.00217 in., and is practically free from hysteresis effect, shown in coincidence of increasing and decreasing values.

A complete extensometer is shown in Fig. 2. The solid steel frame *A* has a cantilever arm *B* integral with the



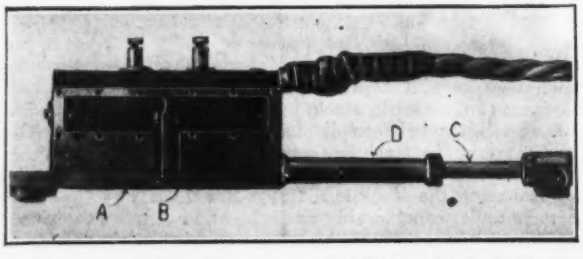


FIG. 2—STRAIN INDICATOR WITH DOUBLE STACK

frame and notched near its upper or fixed end. The rod *C*, threaded into the cantilever, moves in the guide tube *D*. The stacks of carbon rings, assembled on each side of the cantilever, are arranged as two sides of a Wheatstone bridge circuit; a three-conductor wire lead connects them to the indicating device. The span covered by the instrument shown is 8 in., though others have been made ranging in span from 2 to 24 in. with full-scale readings from 0.002 to 0.024 in.

For use the indicator is attached to a member by means of clamps, sharp steel points at either end of the instrument being forced into punch marks in the metal. The force required to operate the instrument depends largely upon the resistance of the cantilever to bending, but this need not exceed 10 lb. as a maximum, which is a small portion of the tensile stess usually involved.

A typical calibration curve for such an instrument is shown in Fig. 2, which exhibits the linear characteristic resulting from the use of the two stacks of plates. The hysteresis effects do not in any case exceed 4 per cent of the full range of the instrument and in most cases are less than 2 per cent.

Twelve instruments of this type have been in use at the Bureau of Standards in tests of 143 lattice girder members which were full-size duplicate parts of the duralumin frame construction of Fleet Airship No. 1, and on fourteen test specimens of large columns for the Delaware River Bridge Commission. Some tests on bridges have been made to verify the applicability of the instrument to field service. Records taken on a steel truss bridge while trains were passing showed vibrations ranging between 2 and 100 cycles per second. With vibrations of this character, repeated tests have shown very little effect on the calibration, and as the free period of the different parts of the apparatus which could introduce sympathetic vibrations was adjusted above 300 cycles per second, or three times the highest frequency recorded, it appears that the deflections must be proportional to the strains.

They have also been applied to the measurement of stresses in airplane stay cables during flight. A similar application has been made to airships. A carbon resistor device for recording the pull on the pressure arm of a machine for testing brake band material has been in service for some months with good results. Experimental applications have been made to the measurement of pressures ranging from a few millimeters of mercury to 40,000 lb. per sq. in.

* * *

Notes on Other Papers

IN *compression tests of babbitt metals*, John R. Freeman, Jr., and Paul F. Brandt, of the Bureau of Standards, tested the effect of varying length of specimen on resulting values of compressibility obtained. They found that the unit deformation is practically independent of length for ratios of length to diameter ranging from 1:1 to 3:1, and that the unit deformation for the central ½-in. length of a 3-in. specimen is the same as for the central 2½-in. length. The total deformation is a function of time of loading, but for loads below appreciable yield a loading time of 30 sec. to 3 min. is sufficient to give reasonably precise results.

Some *data on metallurgical coke* were given by G. S. Perrott and A. C. Fieldner, of the Bureau of Mines. The crushing strength of the coke is found to range from 400 to 2,000 lb. per square inch, which gives a large factor of safety, as the load on the coke in the hearth of a blast furnace averages only 35 to 40 lb. per square inch. The "shatter test" values for coke vary over a large range and depend upon the size of piece tested, so that "it would seem that considerable variations in the shatter test results have little influence on blast furnace performance." The true specific gravity of the metallurgical cokes ranges from 1.84 to 2.10, and the apparent specific gravity from 0.80 to 1.15. The porosity ranges from 40 to 60 per cent, averaging 45 per cent. It is concluded that aside from chemical analysis we are not at present in a position to write specifications for metallurgical coke. Practice shows that any coke having an ash content of less than 13 per cent, sulphur less than 1.25 per cent, true specific gravity over 1.80, porosity less than 55 per cent, and a shatter test over 40 per cent will be satisfactory for blast furnace use.

Quite variable relations between different *consistency tests* —the cube-in-water softening point, the ring-and-ball softening point, the float test, the needle penetration—were found in tests of a variety of tar residues, at the Michigan State Highway Laboratory, reported by J. W. Kennedy. The relation between the different test values depends largely on the amount of free carbon in the tar.

Discussing the question of whether chemical requirements should be included in *cast-iron specifications*, Robert Job and Richard Moldenke agreed that certain chemical specifications are necessary to assure proper results in the production of castings. The main point of the argument was that physical testing of cast iron is not capable of determining satisfactorily all the qualities expected of the finished article. Sulphur and phosphorus are the chief items that should be limited. Combined carbon may also have to be limited in such iron as car-wheel iron.

(Concluded next week)

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Notable Dam

Sir—Mr. Gutmann's description of the high multiple arch dam in Italy (*Engineering News-Record*, May 10, 1923, p. 820) is of great interest to hydraulic engineers.

This dam is remarkable not only for its great height but also for the economy combined with a large factor of safety which this type of dam possesses. Noteworthy is also the steep upstream slope (57 deg. as against the usual 45 to 50 deg.).

Mr. Gutmann refers to the dam as being 200 ft. high. As a matter of fact, the dam rises about 200 ft. above stream-bed, and the foundation of the five highest buttresses extends in an average approximately 28 ft. deeper, thus making the height of the structure 228 ft. Some portions of the buttresses had to be carried to still greater depth, as stated by Mr. Kambo, the designer of the dam. If, therefore, the height of dam is calculated according to the principles expounded in your recent editorial, "How High Is a Dam?" (Nov. 2, 1922, p. 728) the maximum height of the Tirso multiple-arch dam would be 242 ft. by figuring the overall height from the deepest point of the foundation (El. 39.0 m.) to the top of the solid parapet (El. 112.9 m.).

The use of hand-laid stone masonry for the buttresses may have been justified in a country which is noted for its highly skilled stone masons.

For our conditions, concrete would be much preferable both for economic and structural reasons. Mr. Gutmann states that in the construction of the Tirso dam about 20,000,000 lire (nearly $1,000,000 at the present rate of exchange) was saved as compared with the cost of a gravity dam. In order to fully appreciate this remarkable saving, it must be considered also that the factor of safety of a multiple-arch dam is much higher than that of a gravity dam, because by virtue of the sloping upstream face the direction of the water pressure is inclined towards the foundation, and overturning of such a multiple-arch dam is inconceivable. Furthermore, while engineers may argue with regard to the necessity of designing a gravity dam so as to resist under-pressure, there is hardly any need of considering uplift in the case of multiple-arch dams, if the arches are well keyed into deep rock-trenches. For obvious reasons, no under-pressure can exist under the buttresses.

The construction of the Tirso dam marks a great step forward in dam engineering and will pave the way for the construction of high multiple-arch dams also in this country.

San Francisco, Cal., May 24, 1923. FRED A. NOETZLI, Consulting Engineer.

Unbalanced Bids

Sir—Under the caption "False Statement of Quantities Unbalances Bids," Clinton L. Bogert in *Engineering News-Record*, June 7, 1923, p. 998, discusses a question of great interest to all construction engineers and contractors. Obviously if the schedule of quantities submitted constitutes a correct statement of fact, there could be no possible advantage to a contractor in an unbalanced bid. Therefore, the schedule of quantities against which bidders are invited to set unit prices should cover only such items as are known with reasonable definiteness and accuracy. Minor items not susceptible of even preliminary determination may well be set down so as to afford an adequate conception of the magnitude and scope of the undertaking as a whole but should have set against them unit prices which the owner agrees to pay for the same. An owner is largely helpless in the hands of a dishonest or incompetent engineer or achitect, but if these trusted officials are honest and competent there should be little or no unbalancing of bids. It would be unwise for a contractor to accept any quantity estimate without satisfying himself that it is reasonable and, if his investigation leads him to suspect that the quantities are incorrect he surely could not be expected to set aside his own judgment for the sake of submitting a balanced bid.

Let every engineeer and architect, before he sends out a call for bids, endeavor to put himself in the place of the bidder with respect to each and every division of the work with the purpose of determining to his own satisfaction that the specifications and plans would enable him to prepare an accurate estimate of cost which he would be willing to back, not only with his reputation but with his money. When, as is frequently the case, his practical experience has not been such as to afford proper basis of judgment, let him call upon some one of the necessary practical experience to go over the proposition and advise him from a practical standpoint. If such were the practice there would be very few unbalanced bids submitted.

In conclusion it may be said that if every engineer and architect would undertake conscientiously to give his client even approximately that degree of responsible service that he expects to exact from the contractor, construction work would be much more economically done, owners would get greater value for their money and contractors would be enabled to make an honest living without being forced to pit their wits against those of agents in authority.

San Francisco, Calif., June 14, 1923. E. T. THURSTON, Consulting Engineer.

Test of Acid in Dewatering Activated-Sludge at Plainfield Sewage-Works

Sir—In an article in *Engineering News-Record*, March 22, p. 522, C. Lee Peck refers to the "success" of sludge dewatering experiments at Plainfield making use of sulphur dioxide gas. The "success" was a great surprise to me but I passed the matter up at the time feeling that it was possibly within the limits of exaggeration permitted to "efficient sales engineers." However, it seems that the prestige of the *News-Record* together with the faith which has come to be attached to statements from the Plainfield plant has given the statement more weight than the facts will bear.

The only tests made at Plainfield were two runs of 50 and 110 minutes respectively. No pH or other control determinations were made. The sludge to be treated and the effluent from the machine were sampled every ten minutes during the runs for solids, and each wheelbarrow of dewatered cake was sampled and moisture was determined in the mixture of all samples with results as follows:

Length of Run, Minutes	Sludge Treated Gal. per Hr.	Percentage Solids in— Untreated Sludge	Cake from Dewaterer	Effluent from Dewaterer
110	2,000	4.0	12.0	3.4*
50	1,100	4.9	15.4	3.4*

* Solids in effluent from dewaterer constitute 80 and 70 per cent respectively of the original solids in the sludge and are in a colloidal state of division which would make their further treatment almost impossible.

These are positively all the data on the Plainfield tests and I consider them too limited to allow of deductions being made pro or con. JOHN R. DOWNES, Superintendent Plainfield Sewage-Works.

Green Brook Park, Bound Brook, N. J., May 9.

[What Mr. Peck said about the Plainfield plant was embraced in a brief reference to experiments there and at Brooklyn and Indianapolis, as follows:

The Maclachlan process seems to have solved the problem of raw sludge disposal. Maclachlan's experiments at Indianapolis, Brooklyn and Plainfield, N. J., have demonstrated that such sludge can be rendered inoffensive and easily drainable. The sludge is acidulated by injecting hot sulphur dioxide gas. When a hydrogen-ion concentration of pH 3.8 is approached the sludge turns straw color, the colloids coagulate. In this condition it dewaters readily. —EDITOR.]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Alaska Railroad Has Organized a river boat service to operate boats from Nenana on navigable rivers and to connect with the small boats on the upper Tanana, Tolorana, Koyukuk, Iditarod, and Innoko Rivers.

At the Sherman Island Development, Glens Falls, N. Y., water was turned into the power canal on June 25. This is the preliminary step in puttng the first units of this 50,000 hp. power plant into operation.

Grade Separation on the Grand Trunk Ry. through the city of Detroit, Mich., will be started in the near future, and will be carried on until all the grade crossings from the river north to Ferry Ave. have been eliminated.

An Elevated Water-Supply Tank at Fox Lake, Wis., recently failed by the bottom falling out. According to W. G. Kirchoffer, consulting engineer, Madison, the tank had never been painted since its erection and corrosion of the bottom is believed to be responsible for the failure.

The Tax Exemption Period on new dwellings in New York City will be extended to Jan. 1, 1932 by an ordinance adopted by the Board of Aldermen on June 26, and signed several days later by Mayor Hylan. The extension is based on recent state legislation following two court decisions, the first of which denied and the second upheld the constitutionality of the original statute (See *Engineering News-Record*, March 29, p. 598, and May 24, p. 943.)

An Agreement Between the State of New York and the Federal Power Commission whereby the state can drop its suit against the federal water power act without the surrender of authority by either side, seems now assured. Such an agreement will be the result of a conference now in progress at Washington at which all the questions at issue are being discussed with a view to having the commission render certain opinions which will clarify the whole situation.

Another Trunk Railway From New York to the west is proposed by A. H. Smith, president of the New York Central, in suggesting that the Central Railroad of New Jersey be consolidated with the New York Central. Mr. Smith stated that traffic is increasing at such a rate that an additional through line will be necessary within the next four years; that the New York Central has a line from Ashtabula, Ohio, to Newberry Junction, Penn., which is not being used to full capacity, and that by connecting this line to the Jersey Central a new and direct line to the west could be developed.

City Managers Association To Meet With Municipal League

The City Managers Association and the National Municipal League will hold their meetings at the New Willard Hotel, Washington, D. C., Nov. 13 to 17, the conventions overlapping on Nov. 15. John G. Stutz, Lawrence, Kan., is secretary of the managers, and H. W. Dodds, 261 Broadway, New York City, of the league.

High Bridge Not to Be Destroyed

Owing to the report of an engineering committee that High Bridge, spanning the Harlem River near 160th St., New York, can be reconstructed so that navigation beyond it will be unimpeded, the Board of Estimate and Apportionment last Friday decided that the historic structure should not be torn down. The advisory board of engineers and architects headed by Edwin S. Jarrett, presented to the city a plan whereby three main river spans would be replaced by a single steel arch, thus eliminating from the Harlem channel the three piers now obstructive to navigation. This committee advised the city that it would cost about $1,000,000 more to tear down the structure and replace it by an invert or tunnel under the Harlem, reconnecting it with the Croton aqueduct system, than it would to remodel and reconstruct the existing bridge. The committee of engineers has estimated that it will cost only $716,000 to reconstruct, whereas a new structure, together with demolition of the old bridge, would entail an expenditure of about $1,700,000.

On the committee serving with Mr. Jarrett were Donn Barber, Ralph Modjeski, A. Lincoln Bush, J. Vipond Davies and William J. Wilgus.

East St. Louis Enjoins Sanitary Sewer Excavation

A temporary injunction restraining the East Side Levee and Sanitary District from continuing work of digging the drainage canal known as Project No. 12 within the city limits of East St. Louis, Ill., was issued June 23, by Judge Silas Cook of the East St. Louis City Court.

The city petition presented by Special Counsel Thomas Webb and Corporation Counsel R. V. Gustin contends that no permit to dig in the city limits has ever been obtained and that no condemnation proceedings were ever instituted to fix the value of the property which will be damaged by the construction. It further alleged that the crossing of State street would necessitate an excavation 100 ft. wide and greatly impede traffic between East St. Louis and Belleville, Ill.

The injunction is made returnable in September, and the city at that time will attempt to have it made permanent. A. V. Wills and Sons, and H. J. Sternberg, the contractors, have stopped work.

No New Light Shed on Cause of Elevated Disaster

Many Investigations Now Being Carried on By Prominent Engineers—Transit Commission Busy

There has been little progress this week towards the determination of the cause of the fatal accident of June 25 at Atlantic and Flatbush Aves., Brooklyn, in which a two-car elevated train derailed and fell 30 ft. to the street. The primary cause is generally conceded to have been the presence of some object on top of the frog of the crossover switch, and as a bolt was found to be missing from the brake rigging of the leading truck of the forward car, and as the motorman stated that the brake on that car failed to work, an effort is being made to prove that this missing bolt dropped on the frog and caused the derailment. The cause of the fatalities, the falling of the cars into the street, is also still unknown. The supposed "rotten" condition of the wooden guard rails has frequently been stated as the reason for this part of the accident, but in view of the fact that the derailed truck was kept on the deck by these very guard rails it is difficult to see how they are responsible. Moreover the guard rails were not in such a serious condition as some people would like to believe. The report of the Transit Commission inspectors made a few months ago states that out of 230 timbers on this section of the elevated only 3 needed renewal.

B-M. T. Investigation

The B-M T. Co. is conducting an investigation into the cause of the accident and have retained Dwight P. Robinson, J. Vipond Davies, and George H. Pegram to make an examination of the structure at the point of the derailment. The company has also engaged the firm of Parsons, Klapp, Brinckerhoff and Douglas, consulting engineers, to make an examination of the timber deck of the entire elevated structure.

The Transit Commission is also conducting an investigation and are turning over all their reports to the district attorney who in turn has engaged John C. Brackenridge to make a report.

Since the fatal accident on June 25 on the Brooklyn elevated railroad a rumor has been circulating to the effect that the Broadway line between Alabama Ave. and Cypress Hills vibrated so much under the steel trains as to be unsafe. Robert Ridgway, chief engineer of the Transit Commission, in commenting on this states that before the operation of steel cars was permitted on this line extensometers were used to determine the stresses in the structure under the increased loading and that the results of the tests so made indicated that steel cars could be operated on this line with safety. He also stated that since operation started further tests had been made which confirmed the results of the original tests.

Southwest Water-Works Association Meets

200 Attend Gathering at Wichita Falls, Texas—12 Technical Papers Are Presented

Engineering News-Record Staff Report

Two hundred water-works officials and others interested in the Southwest Water Works Association met June 18-21 at Wichita Falls, Tex., and discussed a dozen technical papers presented at the five sessions. The papers, which covered a wide range, were prepared almost entirely by operators and water-works engineers from the eight states comprising the association's field. Municipal versus private ownership and how to eliminate politics are still being discussed vigorously in the Southwest.

The accountants got real assistance from R. O. Grant who has just installed a combined billing and bookkeeping machine at Wichita Falls. His paper was followed by a demonstration. The chemists were served by a paper on "Algae Treatment at Fort Worth" by W. H. Mahlie, chemist, Fort Worth, as well as a discussion on tests for overdosing with alum and chlorine. V. M. Ehlers, state sanitary engineer of Texas, by cartoon effectively illustrated various means by which waters are polluted, particularly small well supplies, and proper methods of pump settings and well location and protection. For the superintendents perhaps the most appealing papers were by J. W. Hockaday, superintendent, Cleburne, Tex., on the "Dollar Value of Meter Maintenance" which gave the return for seven years, and another showing a new service distribution chart by S. L. Williams, superintendent, Wichita Falls.

Entertainment Features

The Southwest Association always makes much of its entertainment features and the hospitality of Wichita Falls permitted none but superlatives in describing these features. The high water mark was an all-day 100-mile automobile trip to the local water pumping plant and filters and then over the $4,500,000 Wichita County Irrigation Project comprising an 85-ft. hydraulic-fill storage reservoir (535,000 acre-ft. capacity) and an earthen diversion dam filled by teams, graders, gas and steam shovels and elevating graders with the compaction by irrigating the surface in 1-ft. layers. This project is financially carried by District 1 comprising the city of Wichita Falls which has little irrigated land. The city badly needed an augmented water supply. The barbecue provided by the Callahan Construction Co., contractors, at the storage dam camp furnished a fitting setting for a description of the project by R. A. Thompson, chief engineer, utilizing a truck for a rostrum. Two of the service gates in the dam, which is nearly completed and has been impounding some of the extraordinary floods of the southwest country, were opened for demonstration of the clockwise swirl in the outlet spillway. Although the main dam is being topped out by the hydraulic dredge the sheer-board method of building the lifts in the main structure, heavy 30-in. repropping of country rock and utilization of a gas shovel in throwing up the toes were visible but not the puddle core as the dam is above the spillway level. The whole work will be near completion in two months. The return trip afforded inspection in many places of the 1,000-sec. ft. 16½-mile canal and structures of which the special features are the consolidation of drops, crossings, wasteways and overflows in various combinations.

The newly elected officers are as follows: President, F. N. Lawton; vice-president, W. F. Anderson; governors, J. W. Hockaday, Texas; E. O. Fowler, Louisiana; R. M. Foster, Jr., Arkansas; H. A. Gallagher, Missouri; B. L. Ulrich, Kansas; G. F. Reinhart, Oklahoma, Joe W. Kelly, New Mexico. R. D. Morgan, Mexia, Tex., was re-elected secretary-treasurer.

Exhibits were put on by twenty-seven members of the Waterworks Manufacturers Association including meters, meter boxes, hydrants, pump valves, chlorinators, chemicals, brass goods, air-lift pumps, filters, pipe cleaning, cast-iron and reinforced-concrete pipe, packing and calking material and pipe cutters. An evening session was given up to a description and moving picture of the making of centrifugal cast-iron pipe.

F. A. E. S. Protests Ousting Davis from Reclamation Service

The Federated American Engineering Societies, through its committee on public affairs, has filed a protest in the office of the Secretary of Interior against the ousting of Arthur P. Davis as director of the Reclamation Service (see *Engineering News-Record*, June 21 and 28, pp. 1099, 1110, 1138 and 1139). On the return of Secretary Work from his Alaskan trip with President Harding the committee will request Secretary Work to explain his action.

Exploding Brick Pavement Wrecks Auto in Illinois

Mr. and Mrs. Earl Rahel of Paris, Ill., narrowly escaped serious injuries June 22 when a section of brick paving on the Chicago road near Paris expanded and buckled under their automobile. The explosion of the road was heard for some distance, bringing farmers from their fields. The concrete foundation was torn out, the front wheels of the automobile were torn off, a tire was ripped from a rear wheel and the machine was thrown to one side of the road. Mr. and Mrs. Rahel were slightly injured by fragments of brick. The intense heat caused the accident.

To Remove Old Superior Viaduct

An order of the War Department has been served on the city of Cleveland to remove the river portion of the old Superior St. viaduct. This structure was superseded by the new High Level viaduct six or seven years ago, but continued in existence largely to serve one or two property owners who had obtained access rights to the deck of the viaduct many years ago. The structure deteriorated to the point of becoming unsafe, however, and was closed as unsafe last year by order of the mayor. The War Department's order is issued in the interests of navigation, and affects the draw span and its support and all parts of the structure that project over the river. The viaduct was built forty-five years ago.

A. G. C. Adopts Standard Form for Advertising Construction Work

The Associated General Contractors has, through its Executive Board, adopted the standard form of official advertisement for construction work which is herewith reproduced. The legality of the form has been verified, and an endeavor will be made by the Association to have the form, which it is believed, will reduce waste and expense, adopted throughout the country.

Proposed Standard Form of Official Advertisement for Construction Work

_____
(*Date Bids Are Wanted*)

_____
(*Location of Work*)

_____
(*Type of Work*)

_____
(*Location of Authority for Advertising*)

Sealed proposals for the construction of—_____ will be received by the _____ of the _____
(*Public Authority*) (*Political Subdivision*)
at their office _____
(*Address*) (*Street*) (*City*) (*State*)
until _____ M. _____ and
(*Hour*) (*Date*) (*Month*) (*Year*)
then publicly opened.

The principal (dimensions or) quantities involved are approximately as follows:

_____

_____

_____

Payments to be made _____ in
(*When*)
_____
(*Cash, Bonds or Special Tax Bills*)
retaining only _____% of the value of materials delivered and work performed, but not exceeding _____ Dollars ($_____) until practical completion of the work.

Limiting funds available _____ Dollars ($_____). The site or right of way for the construction work _____
(*Is or Will Be*)
_____ available _____
(*Immediately or State Date*)

Time of completion _____
(*Insert Date or Number of Working Days*)

Plans, specifications, also forms of proposal, contract and Surety Company Bond or Deposit of Public Securities, amounting to _____
(*Dollars or Per Cent of Bid*)
may be secured by addressing the undersigned or the Designer _____
(*Address*) (*Street*) (*City*) (*State*)
upon deposit of _____
(*Actual Cost of Printing and Postage*)
Dollars ($_____) which will be refunded upon return of plans within fifteen days after bidding date. Each bid must be accompanied by a statement of financial responsibility and previous contracting experience and references and _____
(*Certified Check or Bid Bond*)
for _____ Dollars ($_____) which will be returned to unsuccessful bidders within ten days after bidding date.

Right is reserved to reject any and all bids, or waive any informality in any bid.

_____
(*Signature*)

_____
(*Title*)

_____
(*Address*)

Southern Appalachian Power Conference Meets

Nearly One Hundred Delegates Discuss Power Situation in the South—Recommendations to Congress

Special Correspondence

The second annual meeting of the Southern Appalachian Water Power Conference was held in Asheville, N. C., during June 25, 26 and 27. Nearly 100 delegates attended. The Federal Power Commission was represented by O. C. Merrill, the U. S. G. S. by N. C. Grover, chief hydrographer, and by W. E. King and W. E. Hall, division engineers. Col. H. B. Ferguson came from Washington as the personal representative of the Secretary of War.

Among the papers read, probably the most notable was that of O. C. Merrill on the subject: "Some Popular Fallacies Concerning Power Development." Mr. Merrill pointed out the fact that most of the controversies which are hindering the development of our resources and delaying the extension of utility service rest upon popular ignorance, which gives rise to fallacious opinions concerning the public utility business. Other papers of much interest were presented as follows: One by Maj. Harold G. Fiske, on "Methods Used in Surveying a Large River System;" one by Prof. Chas. E. Ferris, on "Possible Use of Large Crude Oil Engine Units for Stand-by Power Plants"; one by W. W. Ashe, upon the "Relation of Forest Cover to the Silting of Reservoirs."

During one evening the conference was entertained by a lantern slide address by F. G. Baum, in which he unfolded his scheme for a single national super-power system for the United States.

Feature of Convention

The outstanding feature of the convention was the adoption of the plan of reorganization presented by the executive committee. This plan contemplates the creation of three bureaus called the bureau of public relations, the bureau of industrial expansion, and the bureau of research. Believing that the scope of this organization is rather larger than its name implies, the conference voted to amend the name by dropping the word "water."

Among the resolutions adopted by the conference was one urging the Director of the Budget to recommend to Congress in its next budget that the original appropriation of $2,000,000 for the purchase of forest lands on the headwaters of streams, as provided by the "Weeks Law" be restored, and that Congress be urged to restore this original appropriation. The Director of the Budget was further urged to consider the necessity for increasing the appropriation for co-operation with the states in forest fire prevention under the "Weeks Law" to at least $1,000,000 a year.

Another resolution urges the importance of the extension of river navigation wherever possible by the building of navigation-power dams, particularly within the Appalachian South. Another resolution, addressed to the chambers of commerce and similar organizations of the section, calls attention to the fact that the early and full and effective development of water resources is being retarded by popular ignorance of the subject resulting often in unwise legislation and urging that a campaign be carried on for the true enlightenment of the public.

The incoming officers of the Southern Appalachian Power Conference are as follows: President, J. H. Wills, Atlanta, Ga.; vice-president, Col. Edgar Jadwin; secretary, J. A. Switzer, Knoxville, Tenn.; treasurer, Thorndike Saville, Chapel Hill, N. C.; chairman of the Executive Committee, Dr. Jos. Hyde Pratt, Chapel Hill, N. C.

Destructive Bridge Floor Fire

Largest Part of Six-Span Bridge at Stevens Point, Wis., Destroyed by Burning of Timber Floor

On May 30 a six-span bridge crossing the Wisconsin River at Stevens Point, Wis., was practically destroyed by fire. It was an old structure, having been built in 1877, and originally carried an ordinary timber floor. But within recent years, according to M. W. Torkelson, engineer-secretary of the Wisconsin Highway Commission, a new floor was placed, consisting of wood blocks on planks on modern stringers, all creosoted.

"The fire was first reported by tourists," Mr. Torkelson writes, "and when the city fire department arrived it had gained sufficient headway in the stringers under the floor to make it almost impossible to direct a stream of water against it. It seems that the fire spread very rapidly along the stringers underneath the floor, and while the upper portion still was practically intact, a very hot blaze was in progress underneath, and no headway could be made in fighting it until boats had been secured by which the fire could be attacked from beneath. The writer visited the bridge on June 1. At that time the two west spans of the bridge were completely wrecked and had collapsed into the river. The floor was almost completely burned off the two central spans, which were badly distorted by the heat. The upper portion of the floor of the two east spans was practically intact, but an examination of the stringers underneath the floor revealed that they were about two-thirds or three-fourths destroyed. The statement of the firemen who had assisted in fighting the fire was that water seemed to have very little if any effect."

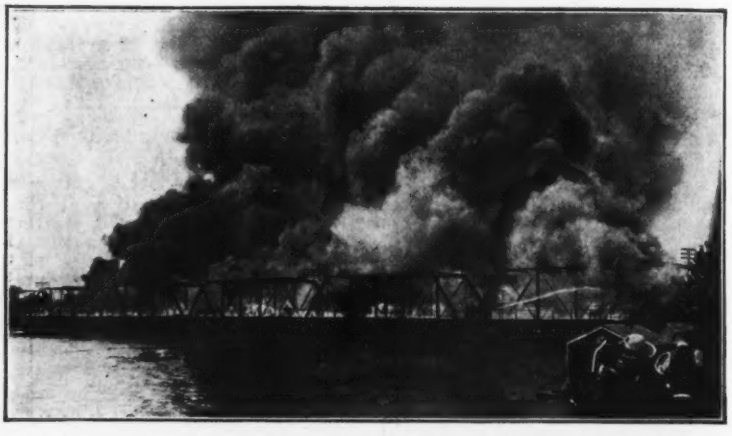
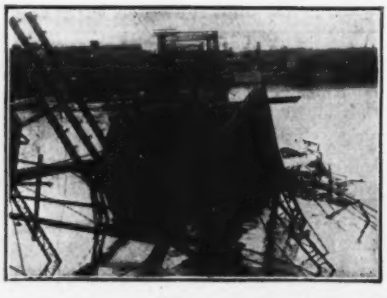


FIG. 1. WISCONSIN RIVER BRIDGE AT STEVENS POINT, WIS., AT HEIGHT OF FIRE, MAY 30



FIGS. 2 AND 3. EFFECT OF FIRE ON BRIDGE
At left, the two west spans which collapsed. At right, floorbeam damage in central spans.

To Straighten Chicago River

Plans for improving railway terminals and developing an industrial district by straightening the bend of the Chicago River between Polk and 17th Streets, have been advanced by the passage of a State bill which grants to the city the State's title to the present river bed, if the city provides a new channel. This bill was prepared because it had been held that in such a change the abandoned river bed would become the property of abutting landowners, so that the city would not be able to carry out the plans for the development of the new area by streets, terminal facilities and an industrial district as outlined in *Engineering News-Record*, May 19. 1921, page 845.

Railway Bridges Damaged in Two Unusual Fires

In One, Fire Starts in Cantilevered Roadway Under Bridge—In Other Oil Cars Burn in River

Two bridges of the Atchison, Topeka & Santa Fe Ry. were damaged by fire recently in unusual manner. The Mississippi River bridge at Fort Madison, Iowa, was damaged by burning of part of the highway deck cantilevered out from the railway portion, requiring difficult repairs which were carried out very rapidly. At Guthrie, Okla., a bridge over the Cimarron River was partly destroyed by gasoline and oil from wrecked tank cars which went into the river as the result of a derailment at the approach to the bridge. This same fire also wrecked a county highway bridge 600 or 700 ft. downstream. Details of the accidents as given by A. F. Robinson, bridge engineer of the system, follow.

The Fort Madison bridge, 2,960 ft. long, has about 1,000 ft. of pile structure with creosoted ballast deck, at the east end. On either side of the railway deck is a wagon driveway, which in the trestle portion descends on a 4 per cent grade to the east until low enough to pass under the railway trestle, from which point it joins the south roadway. On May 24 fire was discovered in the sag of the roadway where it crosses under the railway deck. A strong wind prevailed, and when the fire was put out some 400 lin.ft. were burned and both wagon driveways from the middle of the east steel span to the east bank of the river. It is believed that the fire originated in trash which accumulated in the sag of the roadway, ignited by a cigar or match; it is known that the fire did not originate on the railway deck. The easterly span, 234 ft. long, had the cantilevered driveways and the timber deck burned for about half the span length. Two vertical posts of the downstream truss were badly crippled by heat and many of the jack stringers carrying the wagon driveways were so badly warped that they had to be replaced. This entire span was placed on falsework after the fire. Seventy-foot piles were required, the water being 45 ft. deep. By means of the gates of the Keokuk Dam the water was lowered 18 in. to prevent sawing over the piles and tapping them below permanent water level. A framed timber trestle was built on the caps. Railway traffic across the bridge was restored within four days after the fire, and in another week the wagon driveways were completed. Permanent repairs to the steelwork involved, besides minor work, cutting out about 3 ft. of the two vertical posts which were damaged, and splicing in new material. When this was completed the span was swung by releasing the wedges on the falsework, but it was watched for some time to detect any abnormal deflection as a result of the heating of the steelwork. No trouble of the kind developed however.

The Cimarron River bridge fire occurred on June 6. This bridge has two 210-ft. through truss spans at the north end, followed by four 80-ft. deck girder spans. A southbound freight train approaching the bridge had a car leave the rails, and the portion of the train behind this car did considerable damage to the northerly span in crossing. It knocked the southerly span off the piers and into the water, and eighteen cars of oil went down. Oil and gasoline in the river took fire. Subsequent inspection showed the south span to be a total loss while the north span was so much damaged as to make it uneconomical to attempt to reuse such of the old material as could be repaired. Besides these two spans, the pier between them had its limestone shafts so completely damaged by the heat that it will have to be rebuilt above the water line. In reconstruction, pneumatic piers will be sunk in the middle of the two truss span openings, and 106-ft. girders spans will be placed. Temporarily traffic is being taken care of by a pile bridge upstream of the present bridge, the full length of the crossing. The new bridge is to be built during the present year.

High Brick Wall Collapses in Wind Storm

During a severe wind and thunder storm which swept over Brooklyn, N. Y., during the afternoon of June 26, the whole central section of the northeast wall of the B. M. T. repair yards on Bushwick Parkway was blown over. In falling it crushed an automobile standing near the wall, killing one of the occupants and seriously injuring the other two. The portion of the wall blown over was approximately 240 ft. long and 24 ft. high. It was of brick, 12 in. thick, with 4-in. pilasters at about 10-ft. intervals. There also were two larger pilasters which had evidently been supports for machinery or roof trusses in some structure no longer in existence. Otherwise the wall was unsupported. There were three or four window openings in the wall and one large door opening. An examination of the portion of the wall still standing indicates that the central portion in falling started to rotate about the top of the foundation wall, opening a crack along the inside of the wall at that point, but finally failed along the line of the window sills, falling outward across the sidewalk and well out into the street.

Order Against Chicago Sanitary District Entered

A formal order against the diversion from Lake Michigan of more than 4,167 sec.-ft. (250,000 min.-ft.) of water was entered on June 20 by Judge Carpenter of the federal district court against the Sanitary District of Chicago but the district was given six months to appeal the case to the Supreme Court. The suit was started in 1908. In 1914 the case was tried before Judge K. M. Landis, who did not announce his decision until 1920. Even then he merely handed down an oral decision, with a statement that to give the district a chance to appeal to the War Department for relief he would not put the decision into effect. On the retirement of Judge Landis from the bench without having issued an order the case went to Judge Carpenter, who has been over the testimony and arguments with the result indicated. The oral opinion by Judge Landis, a summary of the case, and a statement of the viewpoint of the Sanitary District officials, appeared in *Engineering News-Record*, July 15, 1920, p. 129; editorial comment was made on p. 99 of the same issue.

Proposed Power Projects Cover Wide Area

Ford Interests Busy on High Dam Plans —Developments Planned in Pennsylvania and the Carolinas

Every effort is being made to push the completion of the plans and the granting of the license for Ford's new dam on the Mississippi at St. Paul. It is probable that the Federal Power Commission will so word the permit as to allow Mr. Ford to erect a steam plant immediately adjacent to the hydro plant. His original plan of having the steam plant in the same building and directly over the hydro plant was abandoned due to the possibility of foundation trouble. The Ford interests are attempting to have the Federal Power Commission reduce the interest rate on the value of the dam from 5 per cent to 4 per cent. The figure 5 per cent was made to conform with that applied to the dam at Troy, which is under a similar lease to Mr. Ford. At present the annual fixed charge is set at $95,000, an amount made up of 5 per cent interest on the value of the structures, which is $1,200,000, 1½ per cent maintenance, and 1½ per cent depreciation.

The Pennsylvania Power & Light Co., a subsidiary of the Electric Bond & Share Co., has made application for a license to develop 47,000 kw. on the Wallenpaupack River near Scranton, Pa. They also propose to construct a reservoir with a storage capacity of 9,000,000,000 ft. As the Wallenpaupack is a tributary of the Delaware, the construction of this large storage reservoir will have a considerable effect upon the proposed development along that river. The latter developments are being held up on account of the fact that New York, Pennsylvania, and New Jersey, having jurisdiction over different sections of the Delaware River, have not been able to agree on their hydro-electric power plans.

Plans for the diversion of the Santee River through a 15-mile canal to the upper reaches of the Cooper River near Moncks Corner are being prepared by the Columbia Railway & Navigation Co. The initial installation will be between 30,000 and 50,000 hp. and will call for a dam which will raise the head to 55 ft. Future installations call for a dike and a higher dam which will raise the head to 70 ft. and permit an installation of 150,000 hp. The feasibility of the project has been enhanced by the progress of the construction of hydro-electric plants and storage reservoirs on the upper tributaries of the Santee, which have raised the low flow of the Santee River from 3,000 to 10,000 cu.ft. per second. The only adverse circumstance affecting the development is the requirement of the War Department that sufficient water pass the dam to maintain navigation on the Santee River.

Contract Let for $6,000,000 Railroad Line in Mexico

For the construction of an 85-mile single-track railroad between La Quemada and Tepic, Mexico the Southern Pacific Railroad has awarded to the Utah Construction Co. a contract amounting to about $6,000,000. This line will give the Southern Pacific an entrance into Mexico City in connection with the National Railways.

Golden Gate Bridge Discussed in San Francisco

At a well attended meeting in the city hall at San Francisco, called to consider the question of bridging the Golden Gate, M. M. O'Shaughnessy, city engineer, explained details of a combined cantilever and suspension bridge for which he had made the foundation explorations, and the superstructure design of which was prepared by J. B. Strauss. This bridge would have a center span of 4,010 ft. with two 1,345-ft. approach spans. The bottom chord would be about 200 ft. above water level and the top chord over the piers would be about 780 ft. above water level. The structure would be designed to carry 30-ton electric cars and the roadway would be 52 ft. wide between curbs. The two piers would be founded on bedrock in 50 ft. of water. The cost of the structure complete with the necessary highway approaches Mr. O'Shaughnessy estimated at $25,000,000.

Other bridges, proposed by Capt. John G. Little as alternative types and estimated to cost $11,000,000 and $14,000,000 respectively, would involve a combination trestle-and-tube structure or a high-level bridge with three 1,100-ft. spans. Either of these structures would be some distance inside the Gate proper, where the water is not nearly so deep, and each would have a length of about four miles. The high bridge would clear the water by 200 ft. and in the other type, the tube, would afford a 1,500 or 2,000-ft., unobstructed channel of a 50-ft. depth.

Details of the enabling act (Assembly bill 1288) passed by the recent legislature authorizing counties to join in assessing a tax levy and issuing bonds for the bridge were explained. Before adjournment, the meeting passed resolutions directed toward petitioning for a hearing before the War Department to determine whether permission for the proposed crossing could be secured.

Bids for Laying Los Angeles Sewer Outlet in Ocean Wanted

Bids for laying 5,184 ft. of 84-in. pipe extending into the Pacific Ocean to a water depth of about 50 ft. and for two 60-in. branches each 283 ft. long ending in some 56 ft. of water, laid at angles of 45 deg. from the 84-in. pipe, are to be received by the Board of Public Works of Los Angeles, Calif., up to 10 a.m. July 30. The pipe will be supplied by the city of Los Angeles at the Hyperion railway siding, free of charge to the pipe-laying contractor. This work constitutes the ocean outlet of the new North Outfall sewer shown on a map printed in *Engineering News-Record*, June 7, p. 1,000.

Alternative bids are invited for Class D standard bell-and-spigot cast-iron pipe and for submarine reinforced-concrete pipe having a special bell-and-spigot joint. The pipe will be laid just below the ocean bottom which has a slope of about 1 per cent from the high-tide line outward. Borings indicate that the bottom consists almost wholly of sand. Piling is required for a distance of 700 ft. through the surf and concrete aprons must be laid around each of the two special outlet fittings, which latter will discharge upwards at a level about 4 ft. above the ocean bottom. John A. Griffin is city engineer and W. T. Knowlton is engineer of sewers.

Washington Award Conferred on Capt. Robert W. Hunt

The Washington Award for 1922, for "pre-eminent services in promoting the public welfare" has been awarded by the Western Society of Engineers to Capt. Robert W. Hunt, Chicago, and the presentation of the heavy bronze tablet mounted on a marble slab was made at the annual dinner of the Society, June 18. The award was

founded in 1916 by John W. Alvord and the recipient is selected annually by a commission representing the Western Society and the four national societies of civil, mechanical, mining and electrical engineers. This distinction is conferred upon Captain Hunt, "for his pioneer work in the development of the steel industry in the United States and for a life devoted to the advancement of the engineering profession."

C. E. Ashburner City Manager of Stockton at $20,000

Charles E. Ashburner, city manager of Norfolk, Va., will become city manager of Stockton, Calif., Sept. 1 at a salary of $20,000 a year, a $4,000 advance over his present salary. Mr. Ashburner is the pioneer city manager of the country, having served as general manager of Staunton, Va., from April, 1908, to July, 1911; and city manager of Springfield, Ohio, from 1914 until he went to Norfolk in the same capacity in 1918. From 1911 to 1914 he was with the American Railways at Lynchburg, Va. Stockton adopted the commissioner-manager plan recently, to go into effect July 1. The population of the city in 1920 was 40,296 against 23,253 in 1910 and 17,506 in 1900. The Staunton general manager plan, which antedated by several years the city manager plan, was described in *Engineering News*, July 8, 1909, p. 32.

Plan Another Rail Line in Mexico

The National Railways of Mexico is contemplating the construction of a 30-mile line southeast from Mexicali, which is on the California-Mexican line in the Imperial Valley, to San Felipe on the Gulf of California, according to an announcement made in San Francisco by J. M. Carpio, assistant director general of the National Railways.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The Rochester, N. Y., Engineering Society elected the following officers at its annual meeting June 8: Waldo G. Wilds, president; Stephen B. Storey and Gloster P. Hevenor, vice-presidents; Walter S. Burch, secretary; and Leonard A. Waasdrop, treasurer.

The Engineers' Society of Pennsylvania at its meeting June 11 installed its officers for the coming year, as follows: Robert W. Moorhead, president; R. L. Gillespie and Charles Haydock, vice-presidents; Howard E. Moses, secretary; and Paul E. Fickenscher, treasurer.

The Engineers' Club of Baltimore is co-operating with a committee on efficiency and economy which has been appointed by Mayor Howard W. Jackson to suggest plans for the reorganization of city departments. Ezra B. Whitman, a member of the Public Service Commission of Maryland, and an engineer, is chairman of the committee named by the Mayor. He has asked Engineers' Club members for suggestions. The club has sent out postals to all its members asking that they make practical suggestions for improvement in the various city departments.

The Dayton, Ohio, Engineers' Club recently elected president Charles H. Paul, chief engineer of the Miami Conservancy District. The vice-presidents are: John H. Hunt, O. B. Reemelin, and C. D. Putnam; J. C. Matthieu is secretary, and Fred L. Kohnle is treasurer.

Personal Notes

L. A. BOULAY, of L. A. Boulay Co., civil and sanitary engineers, Toledo, Ohio, assumed office July 1 as director of highways and public works for the state of Ohio, succeeding Leon C. Herrick. Mr. Boulay, who has lived in Ohio seventeen years, was first deputy engineer in the office of the Lucas County surveyor and later sanitary engineer for Lucas County, after which he organized his own company. His previous service had been varied. He served as civil engineer for the U. S. General Land Office in Utah and in Arizona. As chief engineer Mr. Boulay had charge of the construction of the Benguet R.R., a 40-mile electric line in the Philippines. He was an engineer for the Canton-Hankow R.R. in China, and constructed a 20-mile railroad in Mexico for the Pan

American Co. of New York. For a short time he was a engineer for the District of Columbia on grade crossing elimination and building of the new Washington depot. He was also engineer in charge of construction of the Holguin branch and of the San Luis Potosi railroads in Cuba.

T. C. DESMOND & CO., INC., general contractors, have moved their offices to 247 Park Avenue, New York City, the building being a new twenty-story office building just completed by this company.

SALISBURY & BRADSHAW, consulting engineers, Los Angeles, Calif., announce the association with their firm of ARTHUR TAYLOR, under the firm name of Salisbury, Bradshaw & Taylor. Mr. Taylor has been associated with Mr. Salisbury for many years on several irrigation and development projects, and the three members headed the engineering and construction staff on the Lake Arrowhead project in 1921 and 1922.

GEORGE W. CRAIG, formerly city engineer of Calgary, Alta., has been appointed district engineer for the Asphalt Association, with offices in Chicago, instead of the Portland Cement Association as stated in these columns June 14.

H. A. NOBLE, formerly assistant engineer on irrigation work with the Valier Montana Land & Water Co., Valier, Mont., has joined the force of H. M. Byllesby Engineering and Management Corp., Chicago, as draftsman for concrete and steel.

E. L. CHANDLER, who formerly was division engineer with the Miami Conservancy District on channel improvement work, is now engineer in dam construction in Iowa for Price Brothers Co., contractors, Dayton, Ohio.

M. N. YANCEY has been appointed engineer on construction for the Florida State Road Department. Mr. Yancey was formerly superintendent of bridge construction for the Talbert onstruction Co.

LT. WILLIAM S. KILMER, U.S.A., has been transferred from the Field Artillery to the Corps of Engineers, LT. HUBERT S. MILLER and LT. EDWARD H. COE have been transferred to the Corps of Engineers from the Infantry, LT. EUGENE L. VIDAL has been transferred from the Corps of Engineers to the Air Service and LT. FRED W. MARLOW and LT. THEODORE T. KNAPPEN have resigned from the army.

ANDREW J. PROVOST, JR., consulting engineer, 39 West 38th St., New York City, has been elected chairman of Committee C-4, American Society for Testing Materials, on clay and cement sewer pipe, to succeed Dr. Rudolph Hering, who, at the time of his recent death, had served as chairman for eighteen years.

J. J. ROSEDALE has resigned from the position of chief construction engineer, Department of Safety, California Industrial Accident Commission, and has opened an office in the Sharon Building, San Francisco, as representative of manufacturers of safety and sanitary devices and fire prevention equipment.

MAJOR DONALD H. CONNOLLY, of the Corps of Engineers, has been ordered to Memphis.

MAJOR MILO P. FOX has been ordered to Washington to serve as assistant to Brig. Gen. Harry Taylor. He succeeds Lieut. Col. George D. Pillsbury, who will take a course at the engineer school.

Dr. ELLSWORTH HUNTINGTON has been appointed delegate of Yale University to the Pan-Pacific Scientific Congress to be held in Australia during the summer. Dr. Huntington is the author of "Climatic Changes," "Civilization and Climate," and of a new book, "The Earth and the Sun," which is to appear this fall.

CHARLES G. YALE, who recently retired from active charge of the San Francisco office of the U. S. Geological Survey, was the guest of honor at a banquet given by the San Francisco Section of the American Institute of Mining and Metallurgical Engineers. Mr. Yale had been forty years in the survey office.

W. G. EAGER has been appointed consulting and supervising engineer at Valdosta, Ga., to take charge of the construction of new waterworks planned for that city.

CHARLES LYBROOK, Logansport, Ind., former county surveyor, has been named city engineer to succeed John Paul Davis whose resignation went into effect June 1.

PAUL HAMILTON has been appointed assistant chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis, W. C. KEGLER has been made engineer, track and roadway, of the same road, E. H. MCGOVERN and J. E. KISSEL engineers, maintenance-of-way, and W. B. HODGE office engineer.

JAS. A. OGDEN, rancher and oil operator of Kern County, has been named city manager of Bakersfield, Calif.

W. E. WHALIN, building contractor, has been appointed to suceed Wilfred N. Ball, resigned, as superintendent of construction for the Oakland, Calif., Board of Education.

FRED B. COLE and H. F. KIMBALL, for many years with Charles T. Main, Boston, Mass., and H. E. Osgood, recently representative of the Sanford Riley Stoker Co., have formed a partnership, Cole, Osgood & Kimball, Boston, Mass., to do general engineering work and specialize in power plants, textile and industrial lines.

C. C. CARPENTER has resigned as professor of civil engineering at Ohio Northern University and will devote all his time to structural work, specializing in highway bridges.

HOWARD S. REED has resigned as city engineer at Phoenix, Ariz., and Henry Rieger, assistant city engineer, has been appointed to the position temporarily.

L. C. FRITCH, vice-president of the Chicago, Rock Island & Pacific Ry., has been appointed vice-president and general manager, succeeding T. H. Beacom, resigned.

J. O'NEILL has resigned from the staff of the St. Lawrence Paper Mills at Three Rivers, Quebec, to accept a position with the Thompson-Starrett Co., New Haven, Conn. Mr. O'Neill attended the University of New Brunswick. He has been city engineer of Fredericton, N. B., and assistant engineer with the Henepin Bridge Co., Minneapolis.

W. G. FOWLER has been appointed bridge designer and draftsman with the Missouri State Highway Commission; he previously held a similar position with Heyl & Patterson, Inc., Pittsburgh, Pa.

Obituary

DR. HERMAN M. BIGGS, commissioner of health of the state of New York since 1914, previously known the world over for his bacteriological and pathological work in the field of public health, died in New York City on June 28. He was born at Trumansburg, N. Y., in 1859; graduated from Cornell University and Bellevue Hospital Medical College with the degrees of A.B. and M.D., and continued his studies abroad. From 1892 to 1901 he was pathologist and director of the bacteriological laboratory and from 1901 to 1914 was general medical officer of health of the New York City Health Department.

DR. C. LINCOLN FURBUSH, director of the Department of Health of Philadelphia since 1919 died on June 26. He was born in New York City in 1863. From 1898 to 1902 he was in the medical service of the United States Army. He also served in various capacities during the World War as a colonel in the Medical Corps, U.S.A.

HUGH DOHENY, contractor, president of Hugh Doheny & Co., Ltd., and vice-president of the Canada & Gulf Terminal R.R., died recently at the age of 59. Mr. Doheny was one of the well-known railway builders in Canada. He had built many lines including sections of the Canadian Pacific R.R., the Soo line, the New Hampshire R.R., sections of the Quebec Central, the Sault Ste. Marie Canal, lines in Cape Breton, part of the Temiskaming and Northern Ontario R.R., and many others.

FRANK W. BROOKS, who retired two years ago from the presidency of the Detroit United Rys., died June 28 after a long illness. He was born in Texas in 1864 and his early railroad work was in the engineering department of the Texas & Pacific R.R.

BRIG. GEN. LEWIS T. BRYANT, New Jersey state commissioner of labor, and a graduate civil engineer, died June 27 in Trenton, N. J., aged 49 years. General Bryant was born in Atlantic County, N. J., graduated from the civil engineering department of Pennsylvania Military College at Chester, Pa., and was mustered into the United States Volunteer Army in 1898, being advanced within a few years to brigadier-general In 1904 he was appointed inspector of factories and workshops for the state of New Jersey, and the title was changed that year to commissioner of labor, General Bryant receiving appointments by succeeding governors that carried his term to the present time.

W. A. CAMPBELL, reclamation engineer, died at Jacumba, Calif., June 20. Mr. Campbell was a graduate of the University of Pennsylvania and in 1908 was employed in the construction of Laguna Dam; for several years he was identified with engineering work in the lower Colorado district and for the last five years has been on the Imperial irrigation district engineering staff.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Concrete Mixer Conference Discusses Standards

Manufacturers and Contractors Consider Limiting Building Mixers to Four Sizes and Pavers to Three Sizes

Engineering News-Record Staff Report

TO FURTHER the movement for standardizing construction machinery in the interests of economy and efficiency for both contractor and manufacturer a meeting of concrete mixer manufacturers, contractors and engineers was held in Chicago, June 27 to 29, under the auspices of the Associated General Contractors of America. It was agreed, pending final ratification, to limit building mixers to four sizes and paving mixers to three sizes. A uniform method of measuring and rating mixer drums was approved and standards were fixed for the capacities of water tanks on mixers of various sizes.

In explanation, it may be said that as a result of a conference of construction equipment manufacturers and the Associated General Contractors in January, a standardization steering committee of contractors and mechanical engineers was appointed to arrange discussion with the manufacturers of such equipment as appeared capable of some standardization and to formulate with them a program for carrying on the work. The next step was at a meeting of this committee and a number of concrete mixer manufacturers held in Cleveland, May 21, when an outline was drawn up of the various factors requiring consideration. This outline was then submitted to mixer manufacturers throughout the country with a request that they attend a general meeting for the purpose of making recommendations.

Measurement and Rating

At the Chicago meeting this outline was discussed, and comments, prepared in advance by contractors and a committee of mixer manufacturers, were also submitted. Some of the principal points of discussion are noted below:

1. *Standards of Measurement*—As amended in discussion, the report provides that the standard of measurement of drum capacity shall be a cubic foot of water at 60 deg. F.; that tank capacity shall be measured by the U. S. gallon; that boilers, steam engines and gas engines shall be based on the rating of the American Society of Mechanical Engineers, and electric power apparatus on the ratings of the American Institute of Electrical Engineers.

2. *Method of Measuring Drum*—The steering committee stated that there is a question among manufacturers as to whether measurement should be made with the drum rotating or at rest and whether it is wise to include the carrying capacity of the pick-up buckets, which is available while mixer is in operation.

Both the manufacturers and the contractors agreed that the drum should be at rest and the contractors' statement included the further remarks that the drum should be absolutely level, that the loading device should not be the unit of measurement and that the capacity of the pick-up buckets should not be included, as it is too indefinite and is not easily measured in the field by the purchaser. The conclusion, as adopted after discussion, was that: "The water level capacity of the drum standing still shall be used as the capacity of the drum."

3. *Rating of Drum*—Four types of drums were listed by the steering committee: (A) horizontal drums with opening at both ends; (B) same as (A) but with discharge opening closed during mixing action; (C) tilting drum with vertical axis and single opening; (D) tilting drum with horizontal axis and double opening. The contractors' statement remarked that: "The capacity of mixer drums as given in catalogs is sometimes not dependable. Different makes of mixers with the same rating, handle quite different quantities of material. It would seem, therefore, that mixers of the same type should have the same diameter, same speed, same size of openings and same number of buckets with the same pitch."

As to class A, or non-tilting mixers, it was concluded that for both building and paving mixers the water level capacity of single-opening drums should be approximately, but not more than 107 per cent of, the nominal capacity or rating; and approximately 50 per cent for double-opening drums. Consideration of tilting drums in classes C and D was referred back to the committee of the manufacturers association, as this type of mixer was not represented. Another conclusion adopted was: "The maximum operating grade to be considerer in the rating of paving mixers is 5 per cent."

4. *Table of Aggregate Proportions*—The steering committee proposes to gather information as to the volume of wet concrete produced from various proportions of batches with varying water content and varying voids in the aggregate. The manufacturers' association proposed that a new table be prepared, utilizing the data in the tables of Abrams, Taylor and Thompson, this table to indicate specifically the quantity of water to be considered in rating mixers, together with the voids in the aggregate used. After some discussion this subject was referred back to the steering committee, and was afterwards adopted substantially as above.

5. *Standard Sizes of Mixers*—Protracted discussion from varied points of view followed the presentation of the subject of standard sizes. The advantages to both manufacturer and contractor which will result from the reduction in sizes of mixers was pointed out, but there was evidently much doubt as to two particular points: (1) Whether some manufacturers might seek to retain certain individual advantages by making sizes other than standard; and (2) whether the number and sizes of standard mixers would satisfy the contractors. One maker stated that a certain size proposed to be excluded is one of his best sellers, but he would sacrifice it if assured that no other manufacturer would continue to produce that size. Another maker thought that the contractors are the best judges of what contractors want and will demand, and he would not accept any list of standard sizes unless it was approved by the contractors.

Seven Sizes Approved

It was suggested that for general and building work there should be four sizes: Nos. 4, 7, 14 and 28. But there was wide diversity of opinion as to whether four sizes are sufficient and what these sizes should be. The question of mix came up and it was pointed out that it is very desirable to avoid sizes which would require a half-sack of cement to complete the batch.

A limit of four sizes of mixers for general and building work was approved, but discussion developed some objection to No. 4 and preference for No. 5, so that eventually it was decided to refer the selection of the smallest size to a committee of manufacturers. The possibility of adopting No. 21 as a fifth size was also considered. For paving mixers, two sizes were suggested originally: No. 21 and another approximately half that size. The final action, however, was the adoption of three sizes: No. 7, No. 12 and No. 21.

6. *Measuring Drum Speed*—The suggestion was made that for single-opening drums peripheral speed is preferable to revolutions per minute and that this speed should be measured at the center of mass of the batch. Both speeds to be given by the manufacturer. Finally this was referred back for further consideration.

7. *Water Tanks*—Tanks are to be rated on the amount of water discharged per batch and are to be of the following capacities for standard size of mixers: No. 7, 12 gal., with ¾-in. hose nipple for water supply connection; No. 14, 22 gal. with 1¼-in. pipe; No. 21, 32 gal., with 1¼-in. pipe, and No. 28, 42 gal., with 2-in. pipe connection.

Numerous other subjects which were discussed more briefly and will be covered by the final report included the following:

Building Mixers: Sizes to which

Lubrication of Equipment

On account of the space needed in this department this week for the report on the concrete mixer conference it is necessary to postpone until next week the second installment of the article, "The Lubrication of Construction Equipment," which began in the June 28 issue, p. 1144.—Editor.

Contractors Deny Padded Estimates for Cement

Tell Hoover That Manufacturers Dodge Responsibility for Deliveries in Present Form of Contract

A DENIAL of the accusations, made by cement manufacturers, that contractors over-estimate requirements and duplicate orders for cement for purposes of speculation is made in a letter to Secretary of Commerce Hoover, dated June 25, from J. W. Cowper, president, and other members of the Associated General Contractors of America. The communication is in answer to an earlier letter (dated April 9) received by the Secretary of Commerce from six cement manufacturers (Atlas, Hercules, Penn Allen, Dexter, Lehigh and Alpha). To the statement made by the cement companies that 40 per cent of the cement contracted for on engineering and construction work in 1920 was not required, the contractors reply that this estimate is excessive and that over-ordering during the year did not exceed 10 per cent of production.

The cement manufacturers' letter begins with an explanation of its "specific job contract" under the terms of which the manufacturer agrees to deliver the cement required during the entire construction period of the project at an agreed price. These contracts, the manufacturers state, are made to minimize speculation to the detriment of the public. Padded contracts for cement, it is claimed, are common practice among purchasers, as are also duplicate orders on different manufacturers. This year, the letter states, there is no doubt of an outstanding duplication or padding of contracts for cement running into many million barrels that will not be called for delivery. If it were possible to eliminate them, it is pointed out, this additional amount of cement would be available for sale. This year, cement production is estimated at 125,000,000 bbl. The cement manufacturers close their case with pleas for avoidance of duplicated orders, for limiting estimates for cement to actual needs, and for spreading purchases throughout the year.

Contractors Reply

In their reply the contractors admit that over-ordering or duplicating of orders does occur to a very limited extent, but not as a means of speculation. Cement, the contractors assert, is almost universally sold under a loose form of contract which guarantees the price but which does not bind the seller to deliver a given quantity of material within a given time, a matter of vital importance on highly organized construction work, notably highways. "If the manufacturer and the dealer, who receives a commission on all cement used in his territory, will assume responsibility for delivery at a given time," the letter from the contractors states, "the practice of over-ordering or duplicating can doubtless be eliminated. It has its birth in the trade practices of cement selling, and upon revision of these practices depends its correction. Since the manufacturer does not agree to deliver at a given time or rate, and since the owner demands his project at a given time, the construction company is obliged to accept responsibility for contingencies which neither of these will assume."

The construction companies, it is claimed, are frequently injured by the form of contract insisted upon by the cement manufacturers and have sought its abandonment in favor of a bona fide mutual non-cancellable contract, guaranteeing delivery and acceptance, and relieving the seller from delays of transportation. This offer, it is stated, has been declined by the cement producers.

The general tone to the cement manufacturers' letter and its date lead the contractors to infer that it was conceived in opposition to a construction conference. The contractors' communication to Secretary Hoover concludes with the statement that "the trade association is casting aside many features of the competitive system and has reached that stage of group co-operation where the principal evils of the competitive plan still survive, but where the public has not derived its share of benefit from the co-operation." Industries, the contractors believe, must exercise proper government of themselves. If this course is not followed voluntarily they predict that "it will doubtless be followed under the distasteful pressure of law."

(*Concluded from p. 36*)

power discharge, extension loaders and rubber tires may be applied. Discharge control from one or both sides. Open or closed ends for skips. Size of skip and rating by heaped load or level load. Standards for wheels will be referred to wheel manufacturers.

Paving Mixers: Sizes to which caterpillar equipment may be applied. Width of skip. Hand or power steering and boom swing. Forward and reverse speeds.

General: Drum gearing. Quality of material. Safety devices. Standardizing of motive power. Standard names for parts. Name plates showing standard rating.

On the basis of the extensive discussion during the three-day meeting the proposed rules for standardization will be revised and submitted for approval.

Business Notes

GRAHAM B. BRIGHT CO., Richmond, Va., has been appointed Virginia representative for the T. L. Smith Co., Milwaukee, manufacturer of concrete mixers, pavers, excavators and loaders.

C. E. ROWLEY has resigned as advertising manager of the Novo Engine Co., Lansing, Mich., and is succeeded by R. P. Ostrander.

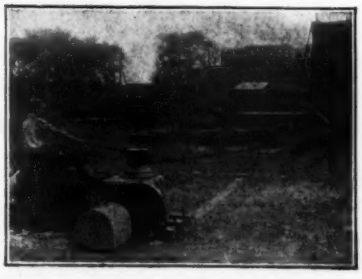
B. L. G. REES, who joined the business staff of *Engineering News-Record* Feb. 2, has resigned, effective July 1, to become New England advertising manager of *The Nation's Business*, the monthly publication of the Chamber of Commerce of the United States. He will cover the New England and half of the New York territory, with headquarters in New York City.

EDWARD W. BUCKLEY has been appointed by the Mayor to the newly created position of Commissioner of Purchase of the City of New York, effective July 1. He was formerly deputy state tax commissioner.

Equipment and Materials

Electric Capstan Car Puller

A new product of the Gifford-Wood Co., Hudson, N. Y., is an electric capstan car puller for use in spotting freight cars to be loaded or unloaded on sidings at industrial plants. The equipment is inclosed by cast-iron housing and consists of a 5-hp., 1200-r.p.m. electric motor operating the capstan head through either gear or belt drive. The base is held down by five bolts



and occupies an area of 2 ft. 8 in. by 2 ft. 9 in. The housing is split and bolted together so that the upper section, with capstan and bevel gear, may be lifted off to expose all working parts. The equipment produces a rope speed of 44 ft. per minute and a pull on the rope of 2,630 lb. The capstan will pull two loaded cars of 75 tons weight or seven empties of 25 tons each on level track. The device is operated by simply hooking the rope onto the freight car to be pulled, giving it a few turns around the capstan head and throwing the motor switch.

¾-Yd. Revolving Shovel Operates With Only One Motor

Only one motor, gasoline or electric, for all operations is a feature of the design of the ¾-yd. revolving, crawler-mounted shovel developed recently by the Northwest Engineering Co., Chicago. The new design involves a form of cable control that eliminates auxiliary engines and reduces the number of racks, gears, and pinions ordinarily required on equipment of this type. Where a gasoline engine is used the power unit is a four-cylinder machine

developing 57 b.hp. at 800 r.p.m. In the case of electric power a 40-hp. squirrel-cage type motor drives the first reduction gear through a full universal joint, thus relieving the motor bearings of any loads due to disalignment resulting from wear or other causes.

A patented dipper control, by cables, makes possible a simple electrical installation. Current is delivered to the travel base through suitable plug-in connections and is transmitted to the

rotating base by means of a set of large collector rings, all wiring being in conduits.

The weight of the shovel, complete, is 53,000 lb., the length of boom between centers 23 ft., and length of dipper stick 14 ft. 3 in. The crowding motion is controlled by cables from the same drums as are used in clamshell or dragline work. The operation of crowding has no effect in reducing the net available digging force which, the manufacturer claims, is the case with crowding mechanism operated by chains or gears.

In the design of the crawler traction the double flanged rollers which ride on the crawler track are of manganese steel and run on 2¾-in. pins of chrome-manganese alloy steel. This combination of metals, the manufacturer states, eliminates the objection of using bronze bushings at this point, for the manganese roller will not freeze to the pin even if lubrication is neglected. The final drive to the crawlers is through a roller chain and socket which is said to be superior to gears on account of the grit and mud usually present in the operation of a power shovel.

The power shovel equipment is interchangeable for operation as a clamshell bucket, dragline, piledriver hammer, lift magnet, or trench hoe.

Concrete Mixers of Record Size Shipped to Canada

T. L. Smith Co., Milwaukee, has just shipped to Hebertsville, Canada, two 4-yd. (112-S) tilting mixers for use on the dam and hydroelectric project at Hebertsville. These mixers are duplicates of the two that were used at the Muscle Shoals project in Alabama and are claimed by the company to be twice as large as any other concrete mixers ever built.

Four 56-S (2-yd.) mixers of this same type are now being built for use on the Wilson Dam project across the Tennessee River, at the foot of Muscle Shoals, on which two of the Smith 4-yd. and two 2-yd. tilting mixers were formerly used.

Publications from the Construction Industry

Road Rollers—HUBER MANUFACTURING CO., Marion, Ohio, features in a 16-p. pamphlet its motor road roller operated by four-cylinder, 50-hp. gasoline engine. The roller has one front and two rear rolls and weighs 20,000 lb. It can be used also as a tractor for pulling road graders.

Welded Pipe Joints—OXWELD ACETYLENE CO., Newark, N. J., has published a 40-p. illustrated booklet containing reprints of articles dealing with the use of welded joints instead of threaded or coupled joints for pipe lines. The ground covered is largely in the oil and gas fields.

Turbines—KERR TURBINE CO., Wellsville, N. Y., has issued an illustrated bulletin describing its plant for the manufacture of steam turbines and gears. The bulletin, which contains 12 p., is the first of a series which will tell the story of the various sizes and types of turbine built by the company in the same way that the present bulletin describes the company's plant.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Lumber Production Steady

The national lumber movement, as observed by the National Lumber Manufacturers Association, declined quite noticeably during the week June 3-9 as compared with the preceding week, though allowance should be made for the fact that reports were received from 26 fewer mills. Production is still much in excess of what it was at this time last year, and is more than normal; shipments are about the same and new business about 15 per cent less.

For all the 396 reporting mills shipments were 89 per cent and orders 70 per cent of production. The corresponding percentages for the Southern pine group were 90 and 69, and for the West Coast 100 and 88. The 359 of the reporting mills that have a normal production figure for the week show actual production to have been 108 per cent of normal, shipments 100 per cent of the same, and orders 80 per cent. Unfilled orders of 133 Southern pine mills are 12,298 cars, equivalent to 261,959,698 ft., a reduction of about 40,000,000 ft. from the previous week. Unfilled orders of the West Coast Lumbermen's Association mills are given as 250,608,857 ft. of cargo business and 7,365 cars of rail trade business.

The following table summarizes the lumber movement for the week, June 3-9, the corresponding week of 1922 and the preceding week of 1923:

	Past Week	Corresponding Week 1922	Preceding Week 1923 (Revised)
Mills	396	379	422
Production	265,825,535	228,007,506	281,543,261
Shipments	235,495,586	231,598,304	268,747,524
Orders	186,025,245	220,878,037	208,077,032

The following figures compare the lumber movement so far this year with the same part of last year:

	Production, Ft.	Shipments, Ft.	Orders, Ft.
1923	5,512,486,896	5,925,685,551	5,933,893,770
1922	4,531,450,101	4,640,944,156	5,060,336,049
1923 Increase	981,036,795	1,284,741,395	873,557,721

Production of Paving Brick

Production of No. 1 paving brick during May, according to the monthly report of the National Paving Brick Manufacturers Association, Cleveland, based on returns from 24 companies, totalled 34,382,000 brick, a slight gain over the April figures. Shipments in May amounted to 26,209,000, while stocks on hand at the end of the month were 77,662,000 brick. Unfilled orders aggregated 96,752,000 brick.

Pig Iron Production in May

Pig-iron production in May, according to figures received by the Department of Commerce, amounted to 3,868,000 tons, as against 2,307,000 tons in May a year ago. Production of merchant pig iron totaled 600,000 tons, as against 250,000 tons in May, 1922. Steel-ingot production, allowing for companies not reporting, amounted to 4 205,000 tons, as compared with 3,948,000 in April and 3,223,000 tons in May of last year.

Building Cost Index Higher

The index, for May, of the cost of building materials entering into the construction of a six-room brick house, as compiled by the Department of Commerce, stood at 214, on a 1913 base, as compared with 209 in April and 176 in May a year ago. Production of oak flooring in May amounted to 34,636,000 ft., as compared with 21,914,000 ft. in May a year ago. Cement production in May amounted to 12,910,000 bbl. and shipments totaled 14,257,000 bbl. for the month. The estimated total bookings for fabricated structural steel in May amounted to 145,000 tons, as against 202,500 a year ago.

Malleable Castings

The Department of Commerce announces 61,950 tons as the total production of malleable castings manufactured for sale during the month of May, 1923, as shown by reports received by the Bureau of the Census. The returns include only those castings manufactured for sale as such and does not include those used in the plants or finished and sold as other products. The returns include the production of 85 establishments and show that these plants were operarted at 70.9 per cent of their total capacity during the month of May. Total shipments for the month were 60,221 tons; orders booked were 49,730 tons; and monthly plant capacity was 87,419 tons.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 1 to 10, are the following:

Tunnel, New York, N. Y., to Rodgers & Hagerty, Inc., $3,467,414.

School, New York, N. Y., for Board of Education, $1,185,000.

Packing plant, Denver, Col., to C. S. Lambie, $1,000,000.

Commercial building, Pittsburgh, Pa., to Dwight P. Robinson Co., Inc., New York, N. Y., $1,000,000.

Cement mill, Manitowoc, Wis., to MacDonald Eng. Co., Chicago, Ill., $1,000,000.

Hotel Madison, Wis., to S. M. Siesel Co., Milwaukee, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 1 to 10, are the following:

Railway, 22 mi., Orchard to Perkins, Idaho, for Oregon Short Line R.R., $3,000,000.

Hospital, Kansas City, Mo., for Heart of America Hospital, $2,000,000.

Hospital, Louisville, Ky., for St. Joseph's Infirmary, $1,500,000.

Gas pipe line, from Ranger-Eastland to Judd, Texas, for Lone Star Gas Co., $1,350,000.

Hotel Milwaukee, Wis., for Hotel Wisconsin, $1,000,000.

Wharf and terminal, Corpus Christi Tex., for Neuces Co., $1,000,000.

Temple, Milwaukee, Wis., for Elks Bldg. Comm., $1,000,000.

Average Weekly Value of June Contracts Let Over Thirty Per Cent Heavier Than in 1922

Total of 2,763 Awards During June, Average Value $68,326 Compared With 1,016 in May, Averaging $215,267

Contracts awarded in the four issues of *Engineering News-Record* during June, totaled $188,786,000 as compared with $218,712,000 in the five issues of May. This represents an average weekly value of $47,196,500 for June, against $43,742,000 during the preceding months.

The weekly average of $47,196,500 for the months of June represents an increase in money value of over 30 per cent above the weekly average for the corresponding period in 1922.

The number of awards totaled 2,763 during June, with an average value of $68,326 as compared with 1,016 in May averaging $215,267 per contract.

Minimum costs observed in Construction News on each class of constructions are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000; and commercial buildings, $150,000.

Of the $188,786,000, a total of $10,199,000 represented Canadian awards, which fell off heavily from the May totals.

The gain during June may be attributed principally to large private building construction. A general falling off in public building construction has been evident during the last month. The marked gains in private projects are exemplified by such instances as the New York Telephone Exchange building, thirty stories, $11,250,000; a twenty-four story office building also in New York, $5,000,000; a twenty-one story bank and office in Chicago, $5,500,000, and a twenty story office also in Chicago, $7,000,000. Other projects include a packing plant, a cement mill, schools, commercial buildings and hotels.

Engineering News-Record Construction Cost Index Number

July, 1923	222.10
June, 1923	220.70
July, 1922	169.70
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced 1.4 points since last month due to stiffening in labor rates. Prices of basic materials remained unchanged during month except for slight drop in lumber. The average rate for common labor is now 54c. Thus, general construction cost is 31 per cent higher than one year ago and 19 per cent under the peak; it is 122 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
June, 1923 *(4 issues of E. N.-R.)*	148
May, 1923 *(5 issues of E. N.-R.)*	171
June, 1922 *(5 issues of E. N.-R.)*	187
1913	100
Yearly	
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 148 for the month of June, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 148 for June, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING JUNE, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Waterworks	.....	$198,000	$253,000	$2,031,000	$1,160,000	$186,000	$3,828,000	$217,000	$4,045,000
Sewers	$295,000	2,360,000	567,000	2,459,000	493,000	249,000	6,423,000	78,000	6,501,000
Bridges	28,000	154,000	178,000	518,000	913,000	241,000	2,032,000	258,000	2,290,000
Excavation, drainage and irrigation	.....	173,000	25,000	174,000	745,000	.....	1,117,000	57,000	1,174,000
Streets and roads	1,201,000	5,538,000	6,354,000	12,202,000	7,352,000	2,984,000	35,631,000	2,409,000	38,040,000
Industrial works	1,755,000	1,648,000	1,970,000	6,969,000	7,183,000	1,857,000	21,382,000	885,000	22,267,000
Buildings	6,516,000	25,198,000	3,923,000	31,744,000	8,299,000	5,998,000	81,678,000	3,012,000	84,690,000
Federal Government	100,000	1,155,000	314,000	112,000	773,000	1,109,000	3,563,000	.....	3,563,000
Miscellaneous	298,000	6,933,000	1,789,000	2,574,000	3,027,000	8,312,000	22,933,000	3,283,000	26,216,000
June, 1923	$10,193,000	$43,357,000	$15,373,000	$58,783,000	$29,945,000	$20,936,000	$178,587,000	$10,199,000	$188,786,000
May, 1923	16,059,000	50,418,000	23,813,000	45,360,000	25,589,000	30,793,000	192,032,000	26,680,000	218,712,000
April, 1923	13,627,000	58,149,000	17,936,000	39,941,000	36,385,000	20,735,000	186,773,000	11,892,000	198,665,000
March, 1923	10,844,000	52,520,000	15,734,000	51,373,000	50,648,000	48,676,000	229,795,000	10,554,000	240,349,000
February, 1923	3,546,000	32,433,000	11,481,000	37,359,000	21,450,000	16,096,000	122,365,000	1,377,000	123,742,000
January, 1923	10,797,000	37,648,000	10,146,000	42,329,000	25,391,000	11,367,000	137,678,000	4,921,000	142,599,000

Labor Rates and Conditions Throughout the Country

Three factors dominate the construction situation: (1) scarcity of certain basic materials and labor, which causes (2) very high cost, which is causing (3) curtailment of building. With these three factors, three others of a a more general nature must be considered: (1) heavy freight traffic caused by (2) heavy production of materials to fill orders already placed. The third general factor is the uncertainty of the stock market.

As proving that present conditions remain favorable to labor, the common-labor rate for the nation, as applied to pick-and-shovel men is placed at 54c. per hour as against 53c. last month, according to *Engineering News-Record* figures. Local building conditions are as follows:

Atlanta—Building continues active with plenty of materials.

Baltimore—Scarcity of skilled building trades mechanics.

Birmingham—Scarcity of hodcarriers and common laborers, due to migration of negro labor to the North.

Boston—Plenty of building trades mechanics except common laborers and bricklayers, latter threaten strike. Construction falling off.

Dallas—Excessive demand for bricklayers; fair demand for carpenters; slight unemployment in common labor. No falling off in building construction.

Denver—Building trades 100 per cent employed.

Detroit—More men available for construction work because of slight unemployment at industrial plants. Demand for men on some jobs causing a "bidding up" of wages in special cases.

Kansas City—Shortage of bricklayers; plenty of other crafts. Structural iron workers granted rise.

Minneapolis—Postponement of many large building projects because of high materials prices.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by—)

Cities	Brick-layers	Car-penters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.90	$0.70	+$0.50	.....	+$0.75	$0.30@.35
Baltimore	1.50	1.00	.80@1.00	.87½	$0.65	.80@1.00	.30@.50
Birmingham	1.00	+1.00	.50@1.00	+.30@.40	.....	+1.25	+.30@.40
Boston	1.25	1.05	1.00@1.25	.82½	+1.05	1.12½	.55@.70
Cincinnati	1.25	1.05	1.05	.82½	1.05	1.05	.45
Chicago	+1.25	1.15	+1.00@1.25	.88½	1.10	+1.25	.82½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.25	.87½
Dallas	1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.37½	1.00	1.00@1.25	.90	1.00	+1.15	.35@.60
Los Angeles	1.25	.87½@1.00	87½@1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.55
Montreal	1.00	.65	.50	+.40	.50	.65	+.30@.35
New Orleans	1.00	+.90	.90	.65	.80	1.00	.35@.40
New York	1.50	1.25	1.50	1.00	1.00	1.12½	.50@.75
Pittsburgh	+1.40	1.20	1.12½	1.00	.....	1.25	.60
St. Louis	1.50	1.25	1.25@1.37½	1.25	+1.25	1.25	.45@.90
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.12½	1.00	1.00	93¾	1.00	1.12½	.50@.62½
Philadelphia	1.37½	1.12½	1.00	.75@1.00	1.10	1.10	.50@.65

Montreal—Scarcity of bricklayers; other crafts plentiful. Hodcarriers and common laborers granted wage advance.

New Orleans—Bricklayers demand wage advance of 25 per cent above present scale, effective July 7. Carpenters granted advance of 5c. per hour without signed agreement. This craft voluntarily reduced its own wage scale during the recent depression, when the matter of wage reductions was being agitated. Negotiations pending with other trades.

New York—Bricklayers awarded contract of $12 per day for two years, an advance of $2 per day above the 1920 basic wage scale, thereby ending the strike begun on May 21. Hodcarriers will also receive $8 against $7 per day during the same period. Inside ironworkers are on strike for forty-four-hour week and abolition of the open shop. Cement and concrete workers are also on strike, demanding $7.50 per day, an increase of 30c. over the rate offered by the employers.

Pittsburgh—Scarcity of hoisting engineers; other crafts plentiful. Very slight slowing down in steel mill operations due to hot weather.

St. Louis—Bonuses of $1 to $3 per day offered bricklayers. Basic wage $1.50 per hr., same as New York. Plasterers who went on strike two weeks ago granted advance from $12 per day to $14. Helpers also granted rise of $1 per day, making present rate $10.

San Francisco—Plenty of work for all trades. Threatened strike of carpenters held up, settlement not yet effected.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Recent declines due mostly to increased production and unusually large old-material supply. Present market, however, trifle steadier. Birmingham base on No. 2 foundry, still $27 per gross ton.

Railway Supplies—Car materials still hold lead in demand at mills. Track supplies higher at Birmingham. Spikes and bolts declined in St. Louis; track bolts somewhat lower at Pittsburgh mill. No change in rails and ties.

Pipe—Birmingham mill base on 6-in. cast-iron pipe remains at $49 per ton. San Francisco warehouses, however, advanced 4-in. and 6-in., $2 per ton. Stiff advances in wrought steel pipe and clay drain tile in St. Louis. Sewer pipe higher in Birmingham, St. Louis and Atlanta, due to increased labor costs.

Road and Paving Materials—Road-oils and asphalt prices firm during month. Expected cut in crude-oil prices due to heavy production and reserve stocks. Granite paving blocks advanced $5 per M. in Boston and 5c. per sq. yd. in St. Louis. Wood blocks higher in Minneapolis and Boston; lower in St. Louis.

Sand, Gravel and Crushed Stone—Gravel, 1 ½-in., up 15c. in Kansas City; ¾-in. down 25c. per cu. yd. in Minneapolis. Sand declined 20c. in Cincinnati and 15c. per ton in Birmingham, during month. Crushed stone declined, somewhat, in Cincinnati, St. Louis and Boston.

Lime—Hydrated finishing, advanced 50c. in Boston and declined 50c. per ton in Dallas. Hydrated common rose 50c. in Boston and 90c. per ton in Cincinnati. Common lump lime dropped 15c. per bbl. in Dallas and $1 per ton in Montreal, during month.

Cement—Prices firm throughout the country. Birmingham quotes advance of 20c. per bbl., due mainly to higher labor costs. Twenty-eight other cities report no change.

Structural Steel—General price level remains unchanged. Bars still quoted at $2.40 per 100 lb., with plates and shapes at $2.50, on new contracts. Price tendency on structurals has been slightly lower recently; inquiries, however, have improved during the last week. Mill operations at about 89 per cent of capacity, against 94 per cent two months ago. Considerable improvement in new plate business, mostly in small lots.

Brick and Hollow Tile—Common brick advanced 20c. in Dallas, 50c. in Detroit and from 50c. to $2.50 per M. in Birmingham, due to increased demand and higher labor costs. Cincinnati, however, reports slight drop in brick. Hollow tile advanced in Cincinnati, Boston and St. Louis. Declines reported in Chicago, Cleveland and Minneapolis; in last mentioned city, drop due to lower delivery charges.

Lumber—Price tendency downward throughout the country, due to falling off in demand. Postponement of building projects responsible for lessened demand. Slight increases in pine, however, reported in Boston and Dallas, with fir tending upward in Cincinnati.

Explosives—Declines reported in New York, St. Louis, Denver, Atlanta and New Orleans on 40 and 60 per cent gelatin dynamite. Dallas, however, quotes slight advance during month.

Scrap—Prices to dealers and producers down $2 per gross ton f. o. b. New York, during month.

Linseed Oil—Raw oil (5 bbl. lots) quoted at $1.13 f. o. b. New York, against $1.16 per gal, one month ago. Chicago quotes $1.28, compared with $1.37, as of June 7. Downward tendency reported in Dallas and Atlanta.

Price advances since last month are indicated by heavy type; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	July 5	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$31.05**	$23.50
Northern Basic	**29.77**	26.50
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	**30.27**	29.16
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**36.25**	29.16
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**27.00**	18.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	**30.76**	27.32
Virginia No. 2 (silicon 2.25 @ 2.75)	**34.17**	28.74
Basic	**28.26**	25.50
Gray Forge	**28.76**	25.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	**31.61**	23.50
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**32.51**	25.17
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**29.77**	25.00
Basic	**28.77**	25.00
Bessemer	**30.27**	25.00

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	July 5	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.....	$43.00	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb	45.00	28@32	2.00*	43.00	43@45
Light rails, 12 to 14 lb	45.00	30@35	2.00*	43.00	43@45
Light rails, 25 to 45 lb	45.00	30@35	2.00*	43.00	43@45
Rerolled Rails	39.00	28.00	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.45
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	July 5	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$3.15	$2.25@2.35	$3.00	$4.00	$5.00	$3.75
Track bolts	4.00@4.25	3.25	4.00	5.00	6.20	4.70
Standard section angle bars	2.75	2.40	2.75	4.00	4.25	3.10

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	⅛ to 1¼	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½ to 4	26	11
7 and 8	56	43½	4½ to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	60	49½	⅛ to 1¼	38	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
⅛ to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%

	Galvanized		
	New York	Chicago	St. Louis
⅛ to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York				
	Birmingham Mill	July 5	One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$53.00	$67.30	$55.80	$64.20	$61.60	$66.00
6 in. and over	49.00	62.30	50.80	60.20	57.50	62.00

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	July 5	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	$50.00	$62.50	.....	$73.00
4	55.00	50.00	50.00	75.00	$76.50	83.00
5	80.00	80.00	.....	100.00	97.75	108.00
6	105.00	100.00	85.00	175.00	127.50	133.00
8	170.00	150.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.114	.....	.....	$0.15	$0.12	.....
4	...	.114	$0.11	$0.1175	.15	.15	$0.12
5	...	.171	.1375	.....	.23	.18	.16
6	$0.24	.171	.165	.1645	.23	.21	.185
8	.38	.266	.26	.26	.35	.30	.30
10	.57	.399	.338	.364	.53	.42	.441
12	.72	.513	.442	.468	.68	.54	.567
15	1.13†	.684	.65	.78†	.90	.99	.819
18	1.65†	.95	.85	1.092†	1.25	1.32	1.071
20	1.98†	1.14	1.125	.....	1.50	.....	.....
22	2.64†	1.52	1.375	1.456†	2.00	.....	1.44
24	2.97†	1.71	1.625	1.872†	2.25	2.16	1.89
27	4.81†	2.99	....	2.95†	4.69†	3.00	3.34
30	5.33†	3.312	....	3.65†	5.94†	3.60	4.06
33	6.93†	4.41	....	4.45†	6.88†	.....	4.99
36	7.91†	5.0225	....	4.80†	7.50†	.....	5.42

	3	5	8	12	24	36
Boston	$0.127	$0.195	$0.308	$0.595	$1.975†	$5.90†
Minneapolis	.....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.36	.72†	2.60†	.....
Los Angeles	.13	.165	.275	.495	1.65	.....
New Orleans	.112*	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1.80	4.10†
Atlanta	.11*	.165*	.275	.4675	1.7875	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	.126	.189	.294	.567	1.89	5.4375
Kansas City, Mo	.15*	.21	.33	.40	1.60	.....
Philadelphia	.....	.....	.....	.....	.....	.....

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	July 5	One Year Ago
New York, 45% asphalt (at terminal)	$0.0525	$0.05
New York, 65% asphalt (at terminal)	.0525	.045
New York, binder (at terminal)	.06	.0575
New York, flux (at terminal)	.0575	.055
New York, liquid asphalt (at terminal)	.06	.06
St. Louis, 50@60% asphalt	.0565	.05
St. Louis, 40@50% asphalt	.0535	.....
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.049	.10
Dallas, 55% asphalt	.0455	.13
Dallas, binder	.061	.15
San Francisco, binder, per ton	9.50*	13.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$19 00	$15.00
Boston (*Mexican*)	21.00	17 00
Chicago (*Standolind*)	22.25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00*	11.00*
Dallas, (*Texas*)	27.10	21.10
Seattle, "D" grade (*California*)	24.75	20.50†
Denver (*California*)	24 00	....
Minneapolis *f.o.b. Twin Cities* (*Standolind*)	25 45	19.10
St. Louis (*Mexican*)	29.50	24.50
Baltimore (*Standard Oil*)	21.00	15.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	26.00	23 50
Detroit (*Mexican*)	22 47	18.40
Cincinnati (*Kentucky Rock*)	22.50	19.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	....	....
Kansas City (*Texas*)	27.30	22 30
Los Angeles "D" grade (*California*)	17.00‡	11.00‡

*Freight to San Francisco, 80c. per ton.
†F.o.b. Richmond, Cal.
‡F.o.b. El Segundo refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$134.50 per M.
Chicago	About 4x8x4 dressed	3.50 per sq.yd.
	About 4x8x4 common	3.10 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	135.00 per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	106.00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	138.00 per M.
St. Louis	4x8x4 dressed	3.15 per sq.yd.
	4x8x4 common	2.95 per sq.yd.
Kansas City	Granite	3.55 per sq.yd.
Philadelphia	Granite	.... per M.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	12 in. wide	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.45 per lin.ft. *Chicago*: 5 x 8 in., $1.65; 6 x 8 in., $1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2 68
New York (*delivered*)	3½	16	2 70
Boston	3½	18	2 70
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.55
St. Louis	4	16	2 90
Seattle	4	16	Off market
Minneapolis	3½	16	2 73
Atlanta	3½	16	2 00
New Orleans	3	16	2 45
New Orleans	3½	16	2.65
New Orleans	4	16	2.95
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	2.75
Philadelphia	4	16	....

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	July 5	One Year Ago	July 5	One Year Ago	July 5	One Year Ago
New York	$2 25	$1.75	$2.25	$1.75	$1.25	$1.00
Denver	1.90	1.75	1.90	1.75	1.00	0.75
Chicago	2.00	1.80	2.00	1.80	2.00	1.80
St. Louis	2.40	1.25†	2.45	1.30†	2.10	1.10†
Seattle	1.25	1.10	1.25	1.10	1.25	1.10
Dallas	2.25	2.25	2.25	2.25	1.95	2.25
Minneapolis	1.85*	1.50	1.85*	1.50	1.25	1.00*
Cincinnati	1.50†	1.87½	1.50†	1.87½	1.50†	1.43
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1.50†	2.40	1.50†	2.40	1.20†	1.65
New Orleans	2.85	2.08½	2.85	2.08½	1.25	1.35
Los Angeles	1.35†	1.50†	1.45†	1.50†	1.10†	1.35†
Atlanta	1.90†	1.85†	1.90†	1.85†	1.24†	1.15†
Detroit	1.62	2.00	1.62	2.00	2.02½	2.00
Baltimore	1.86	1.40	2.06	1.60	0.80†	2.00
Montreal	1.25†	1.25†	1.50†	1.50†	1 25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.30†	1.28†
Philadelphia	....	1.35	....	1.60	....	1.60
Kansas City	1.75	2.00	1.60	2.00	0.66†*	1.20

New York—Grit, $1.75 per cu. yd.; ready mixed, $2.25
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	July 5	One Year Ago	July 5	One Year Ago
New York	$1.65	$1.65	$1.75	$1.75
Chicago	2.00	1.60	2.00	1.60
St. Louis	1.75	1.65	1.65	1.65
Dallas	2.50	2.73	2.50	2.73
San Francisco	2.15	2.85	2.15	2.25
Boston	1.70*	3.00*	1.70*	3.00*
Minneapolis, at plant	2 00	2.00	2.25	2.25
Kansas City	1.50	2.10	1.50	2.10
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	1.90*	2 00*	1.90*
Cincinnati	1.65*	1.75	1.65*	1.75
Los Angeles	1.60	1.75*	1.60	1.85*
Detroit	1.75	1.90*	1.75	1.90*
Baltimore	2.50	1.75*	2.55	1.65*
Montreal	1.80*	1.90*	1.90*	2.00*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Philadelphia	....	1.70*	....	1.55*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	0.85	0.90	2.50	....
Birmingham, Ala.	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J.	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18 20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	23 20	20.00	3.75*	3.00*
Boston	22.50	15.50	4.25*	2.50*
Dallas	22.00	22 00	....	3.35†
Cincinnati	16.80	14.30	....	....
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	21.00 (white)	1.70†	1.50†
Denver	24.00	....	....	2.70†
Detroit	21.00	20.00	....	20.00‡
Seattle *paper sacks*	24.00	....	2.30†	....
Los Angeles	....	....	....	2.60*
Baltimore	24.25	17.25	2.55	....
Montreal	21.00	21.00	....	10.00‡
Atlanta	23.50	15.00	2.35†	1.50†
New Orleans	....	....	2.40†	....
Philadelphia	....	....	....	....
Kansas City	28.00	24 00	3.12*	2.96*
Birmingham	14 25	13.50	1.90†	1.65†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	July 5	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale)	2.70	0.80 per bag
St. Louis (Carney)	2 85	2.10
Birmingham (Magnolia)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	July 5	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	$2.40@2.50
New York, alongside dock to dealers	2.30	2.30	2.10
Jersey City	2.48	2.48	2.28
Boston	2.80	2.80	2.50
Chicago	2.20	2.20	2.05
Pittsburgh	2 24	2.24	2.09
Cleveland	2.46	2.46	2.31
Detroit	2.48	2.48	2.33
Indianapolis	2.41	2.41	2.26
Toledo	2.48	2.48	2.33
Milwaukee	2.37	2.37	2.22
Duluth	2.14	2.14	2.02
Peoria	2.41	2.41	2.26
Cedar Rapids	2.48	2.48	2.33
Davenport	2.43	2.43	2.28
St. Louis	2.35	2.35	2.20
San Francisco	2.71	2.71	2.63
New Orleans	3.30	3.30	3.20
Minneapolis	2.39	2.39	2.29
Denver	2.84	2.84	2.90
Seattle	2.90	2.90	2.90
Dallas	2.25	2.25	2.25
Atlanta	2.85	2.85	2.34
Cincinnati	2.54	2.54	2.39
Los Angeles	3.20	3.20	3.30
Baltimore	2.65	2.65	2.50
Birmingham	2.70	2.50	2.10
Kansas City	2 45	2.45	2.40
Montreal	2.25	2.25	2.88
Philadelphia	....	2.41	2.31
St. Paul	2.39	2.39	2 29

NOTE—Bags 10c. each. 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.20
Universal, Pa.	2.00	Leeds, Ala.	2.20
Steelton, Minn.	1.95	Hannibal, Mo.	2.10
Fordwick, Va.	2.10	Lehigh Valley District	2.10
Mitchell, Ind.	2.10	Wyandotte, Mich.	2.30
Iola, Kan.	2.10	Alpena, Mich.	2.10
Mason City, Ia.	2.10	Richard City, Tenn.	2.20
La Salle, Ill.	2.10	Kingsport, Tenn.	2.20

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	Warehouse: St. Louis	Warehouse: Dallas	Warehouse: San Francisco
032	22	$0.95	$1.02	$1.24	$1.04	$1.12	$1.16
049	28	1.20	1.30	1.58	1.32	1.38	1.47
068	35	1.47	1.59	1.94	1.62	1.67	1.81
093	45	1.89	2.04	2.50	2.08	2.00	2.32
126	57	2.34	2.53	3.09	2.59	2.55	2.88
153	68	2.79	3.02	3.60	3.08	3.15	.....
180	78	3.20	3.47	5.22	3.54	3.47	.....
245	103	4.22	4.57	4.60	4.66	4.58	.....
287	119	4.88	5.28	6.44	5.39	5.26	6.00
336	138	5.66	6.13	7.39	6.25	6.11	.....
395	160	6.56	7.10	8.67	7.25	7.12	.....
			PAVING				
036P	17	$0.72	$0.78	$0.95	$0.79	$0.76	.....
053P	24	1.02	1.10	1.35	1.12	1.07	.....
072P	31	1.29	1.40	1.71	1.42	1.39	.....
097P	40	1.66	1.80	2.20	1.83	1.90	.....
049R	24	....	1.10	....	1.12	1.07	.....
067R	31	....	1.40	....	1.42	1.39	.....
089R	40	....	1.80	....	1.83	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22.00	$21.25	$20.72	$21.43	$25.50
26 "	2.5	22.00	22.50	22.39	20.78	27.58
25 "	3.0	22.00	25.25	24.93	.....	30.71
24 "	3.4	24.00	27.25	27.10	24.88	33.16
22 "	4.33	27.00	31.75	32.27	.....	35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger..	$2.40	$2.65	$3.54	$3.32½	$3.35	$3.80	$3.65
⅝.....	2.45	2.75	3.59	3.37½	3.40	3.85	3.70
¾.....	2.50	2.85	3.64	3.42½	3.45	3.90	3.75
⅞.....	2.65	2.90	3.69	3.57½	3.60	4.05	3.90
1.....	2.90	2.95	4.04	3.82½	3.85	4.30	4.15

Includes 15c charge for cutting to lengths of 2 ft. and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2.30	$3.05	$3.50	½.....	$2.55	$3.30	$3.75
⅝ in.....	2.35	3.10	3.55	¾.....	2.80	3.50	4.00
⅞.....	2.40	3.15	3.60	1.....	.....	.....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: July 5	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 4-inch*
New York (del.).....	$23.50	$23.50	$24.60	$46.50	$54.00
New York (at dock)...	20.00	20.00	21.00	.....	.....
Chicago.....	11.00	11.00	11.00	34.00	42.00
St. Louis, salmon.....	16@18†	16@18	14.00	38@40	40@44.50
Denver, salmon.....	12.00	12.00	12.00	.....	.....
Dallas.....	13.50	12.90	11.15	33.00	.....
San Francisco.....	15.00	15.00	15.00	.....	.....
Los Angeles (del.).....	15.00	15.00	15.00	(not used)	
Boston (del.).....	22.50	22.50	16.00	48.25	56.00
Minneapolis (del.).....	17@19	17@19	17@18	.....	.....
Kansas City.....	14.50	14.50	14.50	.....	.....
Seattle.....	13.00	13.00	14.00	50.00	.....
Cincinnati.....	17@20	20.00	15.00	45.00	60.00
Montreal.....	16.50	16.50	16.00	100.00‡	68.00
Detroit (del.).....	20.00	19.50	16.50	38.50	41.50
Baltimore (del.).....	21.00	21.00	20.00	40.00	45.00
Atlanta.....	14.00	14.00	11.00	40.00	45.00
New Orleans.....	18.75	18.75	12.50	.....	.....
Birmingham.....	13@16	12.50	12.00	.....	.....
Philadelphia.....	.....	19@25	17@18	40.00	48.00
Pittsburgh (del.).....	16.00	16.00	16@18	.....	.....
Cleveland.....	16.00	16.00	14.00	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: July 5 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12..	$0.1573	$0.1112	$0.0784	.....	$.092	$0.108	.....
6x12x12...	.2097	.1667	.0996	.....	.126	.156	.....
8x12x12...	.2621	.2084	.1358	.....	.170	.244	$0.2691
10x12x12...	.....	.....	.1695	.....	.20	.....	.3505
12x12x12...	.....	.....	.1937	.....	.24	.....	.4206

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	$0.115	$0.22	.....
Minneapolis (f.o.b. cars).....	.0736	.12125	$0.214
Minneapolis (delivered).....	.0816	.13375	.234
Cincinnati.....	.0815	.153	....
Kansas City.....	.083	.1455	....
Denver.....	.065	.123	.188
Seattle (delivered).....	.11	.25	.36
Los Angeles factory.....	.10	.175	....
New Orleans.....	.12	.23	....
Detroit (delivered).....	.1145	.2147	.27
Montreal.....	.115	.225	.30
Baltimore.....	.125	.27	.....
Atlanta.....	.109	.1832	.....
Dallas.....	.115	.....	.....
Birmingham.....	.11	.18	.....
Pittsburgh (delivered).....	.068	.128	.179
Cleveland.....	.09	.172	.....

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Warehouse: Dallas	Warehouse: St. Louis	Warehouse: Chicago	Warehouse: San Francisco
Beams, 3 to 15 in.....	$2.50	$2.75	$3.64	$4.30	$3.45	$3.40	$3.95
Channels, 3 to 15 in....	2.50	2.75	3.64	4.30	3.45	3.40	3.95
Angles, 3 to 16 in., ¼ in. thick.....	2.50	2.75	3.64	4.30	3.45	3.40	3.95
Tees, 3 in. and larger...	2.50	2.75	3.64	4.30	3.50	3.40	3.95
Plates, ¼ in. thick and heavier.....	2.50	2.75	3.64	4.40	3.45	3.40	3.95

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York July 5	Warehouse: New York One Yr. Ago	Warehouse: Chicago	Warehouse: St. Louis	Warehouse: San Francisco	Warehouse: Dallas
½ in. and larger	$3.25	$4.40	$3.60	$3.75	$4.15	$5.00	$4.95
CONE HEAD BOILER							
½ in. and larger	$3.35	$4.50	$3.70	$3.85	$4.25	$5.10	$5.05
⅝ and ¾.....	3.50	4.66	3.86	4.00	4.40	5.25	5.20
⅞ and 1.....	3.75	4.90	4.10	4.25	4.60	5.50	5.45

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$3.00	$3.45	$4.30	$4.25	$3.45	$4.95
Cut.....	....	5.50	5.80	5.75	3.74	5.00

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in.) f.o.b. Philadelphia, L.c.l., $5.85 per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb.....	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	38.75
Asphalt felt (light), per ton, f.o.b. plant*.....	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*.....	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" and "A" grades, at discount of 84 per cent from standard lists, f.o.b. New York; "B" grade less 85 per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$3.00	$4.45	$4.15	$5.10	$4.59
No. 12.....	3.10	4.50	4.20	5.15	4.64
No. 14.....	3.20	4.55	4.25	5.20	4.69
No. 16.....	3.40	4.65	4.35	5.25	4.79
Black					
*Nos. 18 and 20.....	3.70	5.00	4.85	5.95	4.95
*Nos. 22 and 24.....	3.75	5.05	4.85	6.00	5.00
*No. 25.....	3.80	5.10	4.90	6.05	5.05
*No. 28.....	3.85	5.20	5.00	6.15	5.15
Galvanized-					
No. 10.....	4.00	5.35	5.10	6.50	5.15
No. 12.....	4.10	5.45	5.20	6.60	5.25
No. 14.....	4.10	5.45	5.20	6.75	5.25
Nos. 17 to 21.....	4.40	5.75	....	6.90	5.55
Nos. 22 and 24.....	4.55	5.90	5.65	6.05	5.70
*Nos. 25 and 26.....	4.70	6.05	5.80	6.20	5.85
*No. 28.....	5.00	6.35	6.10	6.50	6.15

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: July 5	New York: One Year Ago	Chicago: July 5	Chicago: One Year Ago
Raw in barrels (5 bbl. lots).....	$1.15	$0.90	$1.28	$0.96

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	July 5		1 Year Ago		July 5	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	14.50	16.00	12.50	14.00	14.50	12.50
25 and 50-lb. kegs	14.75	16.25	12.75	14.25	14.75	12.75
12½-lb. keg	15.00	16.50	13.00	14.50	15.00	13.00
5-lb. cans	17.50	19.00	15.50	17.00	17.50	15.50
1-lb. cans	19.50	21.00	17.50	19.00	19.50	17.50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00
3x10 and 12	40.00	41.00	42.00	45.00
3x14	42.00	42.00	44.00	46.00
4x10 and 12	40.00	41.00	42.00	45.00
4x14	42.00	42.00	44.00	46.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42.00	$44.00	$46.00
6x14	47.00	49.00	51.00
8x10	42.00	44.00	46.00
8x14	47.00	49.00	51.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$51.00	$52.00	$52.50	$54.50
3x10 to 10x10	55.00	56.00	55.50	57.50
3x12 to 12x12	59.00	60.00	58.50	60.50
3x14 to 14x14	66.00	67.00	63.50	65.50
3x16 to 16x16	71.00	72.00	68.50	70.50
3x18 to 18x18	85.00	86.00	80.50	81.50
4x20 to 20x20	95.00	96.00	91.50	93.50

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8 x 8-In. x 20 Ft. and Under				2 x 12-In. 20 ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$67.00		$62.00	$57.00	$88.00	
Seattle		$31.00				$31.00
New Orleans	31.00				35.00	
Baltimore	33.50	53.00	53.00	60.00	38.00	53.00
Cincinnati	40.00	75.00	75.00	90.00	44.00	80.00
Montreal	50.00					90.00
Los Angeles		53.00				54.00
Denver	40.75	40.75	40.75	40.75		41.75
Minneapolis	43.50	41.50	41.50		46.00	43.75
Atlanta	38.00				42.00	
Dallas	50.00				55.00	
Kansas City	44.25	46.50	46.50		57.25	48.50
Birmingham	34@38				43@50	
Philadelphia						
Detroit	48.75	52.25			61.75	52.25
St. Louis	44.00				56.00	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$90.00	$50.00	$80.00	
Seattle		28.00			$30.00
New Orleans	75.00			34.00	
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal		50.00	37.00	45.00	45.00
Los Angeles		48.00			
Denver		35.25	35.25		34.25
Minneapolis	43.50	41.75	39.50	40.25	38.25
Atlanta	42.00			32.00	
Dallas	50.00			53.50	
Kansas City	69.00	43.50		44.00	45.50
Birmingham	28@32			42.00	
Philadelphia					
Detroit	52.50	39.00		45.50	43.25
St. Louis	45.00			32.00	

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34†
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

† Minimum carload, 40,000 lb.

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

July 5	One Month Ago	One Year Ago
$2.65	$2.65@2.75	$2.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ¼ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ½-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

Boston	$0.16½	New Orleans	$0.18½
New York	.18½	Los Angeles	.18
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.19½
San Francisco	.18	Montreal	.30
Atlanta	.22	Detroit	.19
Denver	.22	Baltimore	.18
Cincinnati	.21	Kansas City	.20½
Dallas	.15	Birmingham	.20½
Philadelphia	.....		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.23	.25
Kansas City	.225	.25
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1967	.2173
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.20	.225
Los Angeles	.17	.20
Atlanta	.23	.2575
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, delivered	.16	.17
New Orleans	.196	.220
San Francisco	.1625	.1925
Philadelphia	.....	.....

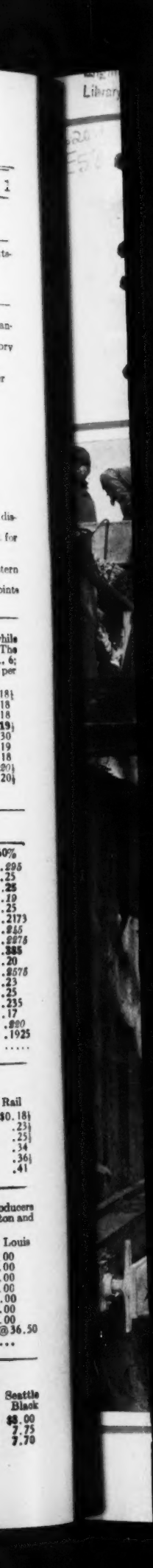
PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15.00	$11.50	$16.00
Stove plate	12.00	12.00	15.00
No. 1 machinery cast	18.00	16.50	20.00
Machine shop turnings	11.00	4.00	12.00
Cast borings	12.00	5.50	13.00
Railroad malleable cast	13.00	12.50	20.00
Re-rolling rails	13.00	13.00	19.00
Relaying rails	.....	30.00	28.50@36.50
Heavy melting steel	12.00	.....	.....

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$9.85	$7.65	$8.00
⅝	7.80	6.30	7.75
¾	7.75	6.15	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50@3.75.